

The Viscount Downe

from the Author.



L. THOMPSON

TINTERN-ABBAY CASE.

ON
THE GROWTH OF PLANTS
IN
CLOSELY GLAZED CASES.

BY
N. B. WARD, F.R.S., F.L.S.

Nulla ibi immodica ventorum vis, nulla tempestatum procella, nullus hyemis horror, non nimia veris humiditas, non torrens æstatis ardor, non molesta et noxia autumnī siccitas, sed temperata et pacifica omnium temporum inter se consonantia.—ROLFINIUS.



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PREFACE TO THE FIRST EDITION.

MOST of the facts detailed in the following work have been long before the public. They have been published in several periodicals, and in a letter to Sir W. J. Hooker, which appeared in the "Companion to the Botanical Magazine" for May, 1836. This letter was subsequently printed separately for private distribution among the Author's friends. The attention of the scientific world was likewise drawn to the subject at three several meetings of the British Association, and more particularly by an admirable paper written by the late Mr. Ellis, of Edinburgh, and published in the "Gardener's Magazine" for September, 1839. The simple yet comprehensive principle, however, upon which plants are grown in closed cases, does not appear to be clearly understood, and many misconceptions yet exist upon this point. The object of the present work, therefore, is to remove these erroneous notions, and thereby to enable those who wish to experiment upon the subject to do so without risk of disappointment. The Author is fearful that in

JAN 19 1926

this attempt he will be condemned by the learned for having entered into needless details, while to those who are wholly unacquainted with the leading principles of botanical science he may not have rendered his meaning sufficiently clear. He has, however, done his best, and can only say in the oft-quoted words of the poet—

“Si quid novisti rectius istis,
Candidus imperti; si non,—his utere mecum.”

A grateful task remains. To the Messrs. Lodiges, who may most justly be styled “*Hortulanorum Principes*,” the thanks of the Author are most especially due. From the very commencement of his inquiries their splendid stores were placed unreservedly at his disposal, and without their kind assistance it would have been difficult for him to have carried on his experiments. He begs likewise to record his obligations to Mr. Aiton, Sir W. J. Hooker, and Mr. Smith, of Kew; to his old friend Mr. Anderson, of the Chelsea Botanic Garden; to Dr. Lindley, of the Horticultural Society’s Garden; to Mr. Macnab, of Edinburgh; Mr. Mackay, of Dublin; Mr. Cameron, of Birmingham; and to various other friends, for numerous specimens of interesting plants received from them at different times for the purposes of experiment.

WELLCLOSE SQUARE, *March*, 1842.

PREFACE TO THE SECOND EDITION.

NOT many years have elapsed since the closed cases were introduced to the notice of the public—their principal applications being, the growth of plants in all situations, even in those unfavourable to their development in the open air, and their conveyance to and from distant countries. As regards the former of these applications, although the use of the cases is daily becoming more extensive, much disappointment has arisen, in many instances; but failures have resulted, in almost all cases, from want of thought or of knowledge, for the Author believes that it would be difficult to specify any plant, intractable of culture in the closed cases, where its natural conditions with respect to heat, light, &c., have been fulfilled. As to the conveyance of plants on shipboard, the plan is now universally adopted, and it is believed that there is not a civilized spot upon the earth's surface which has not, more or less, benefited by their introduction.

But these results are of little moment compared with those which are likely to accrue to animal life by the application of the same principle. This ulterior application has hitherto been considered more in the light of a philosophical abstraction, than as a fact of the highest practical importance. The beneficial influences of light, and of a pure and properly regulated atmosphere, have been, indeed, readily acknowledged by every physiologist, but have not yet received the attention which they deserve at the hands of the legislator, the medical man, or the scientific world at large. The Author first directed attention to this interesting subject in a lecture which Prof. Faraday did him the honour to deliver on the closed cases at the Royal Institution in April 1838, and he has advocated the same cause on various occasions, especially with reference to light* in connection with the question of the abolition of the Window Tax. In the "Illustrated Catalogue of the Great Exhibition," the account of the closed cases was thus concluded:— "The same pure and properly moistened atmosphere which favoured the growth of the most delicate plants in the heart

* See the letters of E. Chadwick, Esq., and Dr. S. Smith, in the Appendix; also, a letter to Sir Joseph Paxton in the Appendix.

of the most crowded cities would prove of incalculable advantage in numerous diseases." The same arguments were used by Sir Joseph Paxton and others in 1851, with reference to the preservation of the Crystal Palace, and the erection of a Sanatorium for the use of the Hospital for Consumption. As this is a subject of vital importance, the Author hopes he may be pardoned in directing the attention of medical men to the possibility of constantly surrounding patients with a pure atmosphere, which, he imagines, will eventually be effected by a combination of vital and chemical forces. It is his firm conviction that, with the progress of science, any climate on the face of the earth will be readily imitated and maintained. The use of the Sanatorium, as recommended by Sir Joseph, would certainly not be of service in all cases of pulmonary complaint, as the atmosphere of the Sanatorium and of the Hospital would necessarily be very different.

A most pleasing duty remains to be fulfilled:—To the Viscount Downe his thanks are especially due for having enabled him to establish some closed cases amongst the poor of his old neighbourhood, under the kind superintendence of his esteemed friend, the Rev. Mr. Quekett. In addition to those friends whose names are

enumerated in the Preface to the First Edition, he begs to thank Mr. Alderman Masters, of Canterbury, who, actuated by love of science, has furnished him with many hundred fine plants; Dr. W. H. Harvey, of Dublin; Mr. H. Christy; Dr. R. Wight, of the East Indies; Dr. Asa Gray, of Cambridge University, United States; and numerous other friends, for plants, &c.; nor must he forget to thank E. W. Cooke, Esq. and Mrs. S. H. Ward for their embellishments of his little volume.

CLAPHAM RISE, *September*, 1852.

TABLE OF CONTENTS.

CHAPTER I.

	PAGE
On the Natural Conditions of Plants	1

CHAPTER II.

On the Causes which interfere with the Natural Conditions of Plants in large Towns	19
---	----

CHAPTER III.

On the Imitation of the Natural Conditions of Plants in closely- glazed Cases	33
--	----

CHAPTER IV.

On the Conveyance of Plants and Seeds on Ship-board	69
---	----

CHAPTER V.

On the Application of the Closed Plan in improving the Condi- tion of the Poor	35
---	----

CHAPTER VI.

On the probable future Application of the preceding Facts . .	101
---	-----

APPENDIX	117
--------------------	-----



ERRATA.

Title-page,		for	Rolfinius	read	Rolfincius.
Page 2, line 8,	8,	flowers		flower.	
" 10, " 25,	25,	requires		require.	
" 12, " 12,	12,	Traille		Traill.	
" 43, " 28,	28,	Blecknum		Blechnum.	
" 44, " 22,	22,	lanciolatum		lanceolatum.	
" 51, " 25,	25,	Soldanell amontana		Soldanella montana.	
" 54, " 7,	7,	Siberica		sibirica.	
" 54, " 8,	8,	Steinbergii		Sternbergii.	
" 60, " 16,	16,	Gloxima		Gloxinia.	
" " 25,	25,	Regina		Reginæ.	
" 67, " 18,	18,	I		We.	
" 73, " 18,	18,	grapes		grasses.	
" 76, " 6,	6,	forty		forty-four.	
" 81, " 16,	16,	dele "and Guthrie."			
" 86, " 3,	3,	for soothes		soothe.	
" 97, " 21,	21,	man		men.	
" 98, " 27,	27,	Sir J. W.		Sir W. J.	
" 114, " 9,	9,	as		so.	
" 131, " 2,	2,	after fecit a comma, not a full stop.			
" 135, " 5,	5,	insert "me" after the word "give."			

Those who wish to make themselves further acquainted with the British Ferns may consult Mr. Newman's "History of British Ferns," a third edition of which is now in the press.

CHAPTER I.

ON THE NATURAL CONDITIONS OF PLANTS.

Can the rush grow up without mire? Can the flag grow without water?—JOB.

There, fed by food they love, to rankest size,
Around the dwelling docks and wormwood rise;
Here the strong mallow strikes her slimy root;
Here the dull nightshade hangs her deadly fruit;
On hills of dust the henbane's faded green,
And pencilled flowers of sickly scent is seen,
At the wall's base the fiery nettle springs,
With fruit globose, and fierce with poisoned stings.
Above, the growth of many a year, is spread
The yellow level of the stonecrop's bed;
In every chink delights the fern to grow
With glossy leaf and tawny bloom below.

CRABBE.



“CONSIDERATE LILIA AGRI, QUOMODO CRESCUNT.”

ON THE NATURAL CONDITIONS OF PLANTS.

To enter into any lengthened detail on the all-important subject of the Natural Conditions of Plants would occupy far too much space; yet to pass it by without special notice, in any work treating of their cultivation, would be impossible. Without a knowledge of the laws which regulate their growth, all our attempts must be empirical

and more or less abortive. When we survey the vegetation on the surface of the earth, we are struck with the endless diversities of form which present themselves to our astonished gaze, from the magnificent palms of the Tropics and the bread-fruit of the Polynesian Islands to the reindeer moss of Lapland, or the red snow of the Arctic regions. Yet the growth of all is governed by immutable laws, and they owe their varying forms to varying climatal conditions.

In Rome upon Palm Sunday
They bear true palms,
The Cardinals bow reverently
And sing old Psalms :
Elsewhere their Psalms are sung
Mid olive branches.
The holly bough supplies their place
Among the avalanches :
More northern climes must be content
With the sad willow.—GOETHE.

HEAT.

The *heat* to which plants are subjected varies from 30° or 40° below zero to 170° or 180° Fahr. In Spitzbergen, the earth in the middle of the short summer is never thawed to more than the depth of a few inches, and the stem of the only *tree*, a little willow, if tree it can be called, runs under ground for several feet within an inch or two of the never-melting ice, whilst in Mexico

the heat rises to 170° or 180° , and the ground is occupied by cactuses, whose structure is such as to enable them to resist the extremest degree of drought. Were it not for such plants, these hot regions would form impassable barriers between neighbouring countries. No water is to be found in these districts, nor anything to eat save the fruit of the Petaya, which Hardy tells us was the sole subsistence of himself and his party for four days. This, unlike other luscious fruit, rather allays than creates thirst, while, at the same time it satisfies, to a certain degree, the sensation of hunger. St. Pierre calls the cactuses, the "Springs of the Desert." The wild ass of the Llanos, too, knows well how to avail himself of these plants. In the dry season, when all animal life flies from the glowing Pampas, when cayman and boa sink into death-like sleep in the dried-up mud; the wild ass alone, traversing the steppes, knows how to quench his thirst, cautiously stripping off the dangerous spines of the melocactus with his hoof, and then, in safety, sucking the cooling vegetable juice. The Providence of God is equally manifested in cold countries, as in Lapland—where the rein-deer moss furnishes the sole food, during winter, of the rein-deer, without which the inhabitants could not exist.

LIGHT.

“ Even as the soil which April’s gentle showers
Have filled with sweetness, and enriched with flowers,
Rears up her suckling plants, still shooting forth
The tender blossoms of her timely birth;
But if denied the beams of cheerly May,
They hang their withered heads and fade away.”

It is hardly possible to overrate the influence of light upon plants. Its intensity, however, varies exceedingly. Sir J. W. Herschel says that the light at the Cape of Good Hope, when compared with that of our brightest summer’s day in England, is as 44° to 27° . In other situations, plants are found growing where the light is not more than half of what would be given by an ordinary candle. Very much of our success in horticulture depends upon the proper amount of light; and, the fact that flowering plants generally require more light than ferns, is one principal reason why the former do not succeed so well in closed cases in rooms, as the latter. A plant of *Linaria Cymbalaria* lived for some years in a closed case on the top of a model of a portion of Tintern Abbey. The branches which grew towards the light, invariably produced leaves of the full size, with perfect flowers and fruit, whilst those branches

which trailed down between the model and the window, and were nearly without light, never produced either flowers or fruit, and the leaves were not more than one-tenth of the ordinary size. This specimen was exhibited to the Chancellor of the Exchequer,* to prove to him the depressing effects of want of light—and want of light *alone*—as all the other conditions of the plant were the same. Some fairy roses, which had flourished in a case standing in the open air for seven or eight years, were nearly killed by being placed in a dark part of the transept of the Great Exhibition for six or seven weeks; this temporary deprivation of light doing more injury than all the variations of our climate for so long a period had been able to effect. Light also, by sustaining the vital energies of a plant, enables it to resist the depressing effects of cold. The secretions of plants, too, are always developed in greater perfection according to the intensity of the light (combined with heat), and this to such a degree that the same species of plant — *e.g. Cannabis sativa* — which is inert in a temperate region, produces, in the tropics, secretions of a powerful and dangerous character.

* Upon the occasion, in 1850, of a deputation waiting on the Chancellor for the abolition of the window duties.

Man makes use of these facts in rendering many plants available for food, that could not otherwise be eaten, as the endive, celery, &c.

“ In North America, the operation of light in colouring the leaves of plants, is sometimes exhibited on a great scale, and in a very striking manner. Over the vast forests of that country clouds sometimes spread, and continue for many days, so as almost entirely to intercept the rays of the sun. In one instance, just about the period of vernalion, the sun had not shone for twenty days, during which time the leaves of the trees had reached nearly their full size, but were of a pale or whitish colour. One forenoon the sun broke through in full brightness, and the colour of the leaves changed so fast, that, by the middle of the afternoon, the whole forest, for many miles in length, exhibited its usual summer's dress.”—Ellis.

MOISTURE.

Without moisture, there can be no vegetation. Whatever may be the degree of heat, or of cold, or deficiency of light, if there be but moisture, plants of some kind are to be found. They form the oases in the sandy deserts, vegetate in the snow of the Arctic regions, and in and on

the borders of thermal springs. The degrees of moisture vary exceedingly. The late Mr. Allan Cunningham often expressed to me his surprise at the extreme dryness of the atmosphere and soil in New Holland, where many species of plants grew, species, too, which did not appear to be constructed like the cactuses, to resist extreme drought; but there, banksias and acacias would live for months without either dew or rain, in soils where not a particle of moisture was to be found on digging several feet below their roots. Numberless other plants, independently of those which live in water, cannot exist unless the atmosphere and soil are saturated with moisture—such as *Trichomanes speciosum*, and numerous tribes of plants which adorn the rocks in waterfalls, &c. One of the most important objects in gardening—but one which is too frequently overlooked—is to furnish plants with the *requisite* amount of moisture. That acute observer, Dr. Hooker, remarks that in Dr. Campbell's garden, at Darjiling (Sikkim Himalaya), there is a perpendicular bank, fifteen feet high, exposed to the west, and partly sheltered from the south-west by a house. *Rhododendron Dalhousiæ* has annually appeared on this, the seeds being imported by the winds, or birds, from the neighbouring forest; the seedlings,

however, perished till within the last two years; since which time there has sprung up abundance of *Lycopodium clavatum*, and a *Selaginella* with *Marchantia*, which retain so constant a supply of moisture, that the *Rhododendron* now flourishes and flowers in perfection. This fact serves to explain why many plants in a state of nature (where the ground is completely covered with vegetation), succeed so much better than in the well-kept garden of the amateur; the continued exhalation from the plants ensuring a constantly moist atmosphere, which is of as much use to vegetation as the rain.

In some countries, as on the coast of Peru, rain scarcely ever falls, but, from May, for six months, a thin veil of clouds covers the coast, from 9 A.M. to 3 P.M. From the first appearance of the cloud, the sand hills, as if by enchantment, assume the features of a beautiful garden. It is a well known fact, that many hilly countries have been rendered quite sterile, in consequence of the indiscriminate destruction of their trees, the roots of which, taking up more water from the deep-seated springs than the plants requires for their own use, distil the surplus through the leaves upon the ground, forming so many centres of fertility. "Spare the forests, especially those which contain the sources of

your streams, for your own sakes, but more especially for that of your children and grandchildren."

REST.

"The meanest herb we trample in the field,
Or in the garden nurture, when its leaf
In autumn dies, forebodes another spring,
And from short slumber wakes to life again."

All plants require rest, and obtain it in some countries by the rigor of winter; in others, by the scorching and arid heat of summer. Cultivators often fail in their attempts to grow certain plants from want of attention to this essential point. Thus, most Alpine plants, which enjoy an unbroken rest under the snow for several months, are very difficult of culture in our mild and varying winters. Messrs. Balfour and Babington, whilst recently exploring the lofty mountains of Harris, found the climate to be so modified by the vicinity of the great Atlantic Ocean, that, notwithstanding their northern latitude (68°), many of the species inhabiting the Highland districts of Scotland were wholly wanting, and the few which they saw were confined to the coldest and most exposed spots. From the same cause many plants grow there which are not known to grow in so northern a latitude in Britain.

The winter of 1850—51 was ushered in by some heavy falls of snow, with which I filled my Alpine case, giving the plants a perfect rest of three or four months, and with a most satisfactory result—the *Primula marginata*, *Linnæa borealis*, and other species, flowering much finer than usual. Many of these beautiful plants would, I am convinced, succeed well, if kept for five or six months in an ice-house.

Plants in hot countries have their periods of rest in the dry season. In Egypt the blue water-lily obtains rest in a curious way. Mr. Traille, the gardener of Ibrahim Pacha, informed me that this plant abounds in several of the canals at Alexandria, which at certain seasons become dry; and the beds of these canals, which quickly become burnt as hard as bricks by the action of the sun, are then used as carriage roads. When the water is again admitted, the plant resumes its growth with redoubled vigour.

On the sandy flats at the Cape of Good Hope the heat is so great, that Sir J. F. W. Herschel, upon one occasion, cooked a mutton-chop on the surface of the burnt soil;* and this extreme heat, coupled with intensity of light, will readily account

* In the Regio calida-sicca of Brazil, the forests that exist have seldom that fulness and lofty growth of those on the coast, and, during the dry months, the leaves are deciduous, on which account they are

for the uncertainty which attends the growth and flowering of Cape bulbs in this country.

There are some countries in which there are two fruit-bearing seasons; where the vine, unable to obtain rest, either from the cold of winter, or the dry heat of summer, is made to bear a second crop of fruit—the ingenuity of man, overcoming obstacles apparently insurmountable. I am indebted to one, who, whilst he is dedicating his life to the holy cause in which he is engaged, does not, at the same time, disdain (to use the quaint but expressive language of Sir Thomas Browne), “to suck divinity from the flowers of nature”—I mean the Bishop of Ceylon, for a knowledge of the fact that at Jafna, the artificial hybernation of the vine, necessary in a tropical country, is produced by laying the roots bare to the depth of two feet, for four or five days, by which time all the leaves are shed. This is done with those that have borne fruit during the first of the two fruiting seasons. They are then pruned, covered again with manure, and constantly watered. In this way the vine is brought to bear fruit, small in size, but

called, in the language of the Brazils, *light-forests* (*Caa-tinga*). What is extraordinary, if no rain falls, they can remain for many years without producing foliage; but when at last the showers descend, in the course of forty-eight hours they are clothed in the most delicate and tender green.

of good flavour. In our own country we often witness the effects produced by continuous heat in long summers. The rest thus obtained causes many plants to flower on the recurrence of autumnal rains, which would not otherwise have flowered until the ensuing spring — as the laburnum and many others.

To suit all the varied conditions to which I have thus briefly alluded, and under which plants have been found to exist, they have been formed of different structures and constitutions, to fit them for the stations they severally hold in creation, so that almost every different region of the globe is characterized by peculiar forms of vegetation, dependent upon climatal differences; and thus a practised botanical eye can, with certainty, in almost all cases, predict the capabilities of any previously unknown country, by an inspection of the plants which it produces. It were much to be wished that those upon whom the welfare of thousands of their starving emigrant countrymen depends, possessed a little more of this most useful knowledge.

But in order to give a clearer idea of the close connexion existing between vegetation and climate, let us take one or two examples from Nature. We shall find some plants restricted to certain situations, whilst others have a wide range, or

greater powers of adaptation. It is not, perhaps, going too far to assert, that no two plants are alike in this particular, or, in other words, that the constitution of every individual plant is different; and nothing would be more delusive than to imagine, that because two plants are found associated in a state of nature, the same treatment would be applicable to both, or that both would be equally amenable to culture. Thus the *Hymenophyllum* and the common London pride (*Saxifraga umbrosa*) are found growing together in rocks on the shores of the Lake of Killarney; the one is so difficult of culture that the Irish have a saying, "that he who can grow the fairy fern is born to good fortune," whilst the *Saxifrage*, on the contrary, will grow in any situation, and will last for years, without the slightest attention, under the most depressing influences.

We have another remarkable example in the *auricula*, which is only found indigenous in the Alps, growing in company with plants, mostly very difficult of culture.

The *Cerasus virginiana* affords an interesting illustration of the effects of climate upon vegetation: in the southern states of America it is a noble tree, attaining one hundred feet in height; in the sandy plains of the Saskatchewan it does

not exceed twenty feet; and at its northern limit, the great Slave Lake, in lat. 62° , it is reduced to a shrub of five feet. Again, in ascending a lofty mountain in tropical regions, we have exhibited to our admiring gaze the different forms of vegetation which are to be seen in all countries, from the bananas, the palms, bamboos, &c., of the plains, to the oaks, beeches, &c., of temperate climes, and the berry-bearing plants of Arctic regions up to the red snow. But we need neither travel to America, nor ascend mountains for instances of this sort; we have them everywhere about us. I have gathered on the chalky borders of a wood in Kent, perfect specimens, in full flower, of *Erythræa centaurium*, consisting of one or two pairs of most minute leaves, with one solitary flower; these were growing on the bare chalk, fully exposed to the sun. By tracing the plant towards, and in, the wood, I found it gradually increasing in size, until its full development was attained in the open parts of the wood, where it became a glorious plant, four or five feet in elevation, and covered with hundreds of flowers. Let us pause here a moment and reflect deeply on the wonders around us. We shall find a continued succession of beauties throughout the year, beginning with the primrose, the violet, and the anemone; these giving place to the or-

chises, and these again to the mulleins, campanulas, and various other plants, all in their turn delighting the eye, and gladdening the heart; nor is the winter season devoid of interest; the surface of the ground, and every decaying leaf and twig, are inhabited by a world of microscopic beauties. All these have maintained their ground without interfering with each other, year after year, and generation after generation. The same page in the great Book of Nature, which filled the mind of Ray with the wisdom of God in creation, lies open to our view. "All these things live for ever for all men, and they are all obedient. All things are double one against another, and He hath made nothing imperfect. One thing establisheth the good of another, and who shall be filled with beholding His glory?" Can man, with all his boasted wisdom, realize such a scene as I have just attempted to depict? He cannot; he would feel that, "when he hath done, then he beginneth, and when he leaveth off, then he shall be doubtful."

I have dwelt at some length on the natural conditions of plants, convinced of the paramount importance of a knowledge of these conditions to *all* cultivators of plants, and cannot do better than sum up in the words of a great philosopher of the present day.

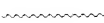
“If the laws of Nature, on the one hand, are invincible opponents, on the other, they are irresistible auxiliaries; and it will not be amiss if we regard them in each of these characters, and consider the great importance of them to mankind:—

“Firstly. In showing us how to avoid attempting impossibilities.

“Secondly. In securing us from important mistakes in attempting what is in itself possible, by means either inadequate, or actually opposed to the ends in view.

“Thirdly. In enabling us to accomplish our ends in the easiest, shortest, most economical, and most effectual manner.

“Fourthly. In inducing us to attempt, and enabling us to accomplish objects, which, but for such knowledge, we should never have thought of undertaking.”—HERSCHEL.

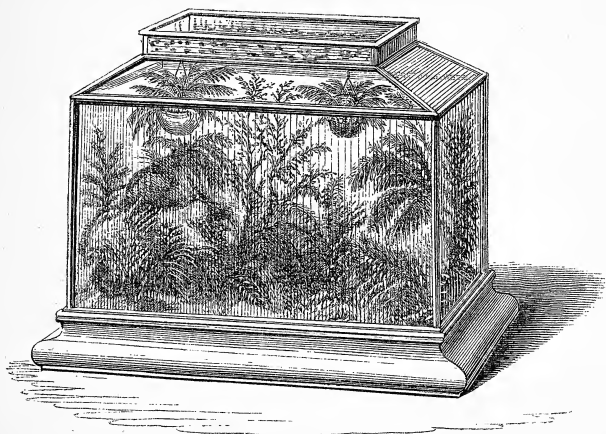


CHAPTER II.

ON THE CAUSES WHICH INTERFERE WITH THE
NATURAL CONDITIONS OF PLANTS
IN LARGE TOWNS.

As well might corn as verse in cities grow ;
In vain the thankless glebe we plough and sow :
Against th' unnatural soil in vain we strive ;
'Tis not a ground in which these plants will thrive.

COWLEY.



ON THE CAUSES WHICH INTERFERE WITH THE
NATURAL CONDITIONS OF PLANTS IN
LARGE TOWNS.

AMONG the causes tending to depress vegetation in large towns, mining districts, &c., may be enumerated, *deficiency of light*, and of *moisture*, the *fuliginous matter* with which the atmosphere is always more or less loaded, and the presence of *noxious gases*.

Enough has been said upon the all-important agency of *light* in the functions of the vegetable system, to convince us that we shall not err in

attributing a portion of the depressing effects upon some plants to *deficiency of light*; but that this cannot be the *sole cause* is clear from the impossibility of growing such plants as ferns and mosses, which can, in any part of London, obtain as much light as they require.

Want of sufficient moisture, again, cannot be the *sole cause*, as long before I began to grow plants in closed cases, my plants in the open air, although constantly supplied with moisture, all perished; and if we examine old walls in London, which, from some cause, are constantly wet, although we find vegetation, that vegetation is not healthy. The conditions for mosses may be so far fulfilled as to allow of the growth of their leaves; and we shall everywhere see, on such walls, the silvery tips, when not obscured by soot, of *Bryum argenteum*; but we must go two or three miles out of London before we find it in fructification. We may, it is true, occasionally find the *Funaria hygrometrica*,* but this is an exception to the general rule.

* The *Funaria hygrometrica* is a remarkable moss, differing widely in its powers of adaptation, and consequently in its greater geographical range, from most of its congeners. It appears to delight as much in heat, as other mosses in cold. There is nothing in its structure to lead us to infer such a difference of constitution. Most mosses are confined within narrow limits, and will not fructify but under certain conditions. The *Funaria* is found in fruit not only in

We must, therefore, look for another and more efficient cause of depression, and this, I believe, is to be found in the sooty particles diffused through the air, interfering with the respiratory functions of the leaves. It is well known, that, *cæteris paribus*, plants with smooth leaves suffer less in London than those which have leaves that are hairy or covered with viscid or resinous secretions. Hence the miserable appearance of most of the *coniferæ* in London, although these are plants, many species of which flourish in the driest sands.

In my letter to Sir W. J. Hooker, published in the "Companion to the Botanical Magazine" for May 1836, I expressed an opinion that the depressing influence of the air of large towns upon vegetation depended *almost entirely* upon the fuliginous matter with which such an atmosphere is impregnated, and which produces similar effects upon the leaves of plants as upon the lungs of animals. This opinion has been questioned by the late Mr. Ellis, in an admirable

London, but in every brick-field around it; in Loddiges' Orchideous house, and in my own large fern-house, where the temperature frequently rises to 120°; and I possess specimens in my *herbarium* from all parts of the world—from Egypt, the Cape of Good Hope, the East and West Indies, New Zealand, New Holland, &c. The peristome of this moss is one of our most beautiful microscopic objects.

paper published in the "Gardener's Magazine" for September 1839, and as the subject is one of great importance, it being impossible to apply remedies without knowing the nature of the disease, I shall discuss it at some length. Mr. Ellis says that the real mode in which such an atmosphere proves injurious to vegetation was first shown by the experiments of Drs. Turner and Christison, which were published in No. XCIII of the "Edinburgh Medical and Surgical Journal." They ascertained that it is not simply to the diffusion of fuliginous matter through the air, but to the presence of sulphurous acid gas, generated in the combustion of coal, that the mischief is to be ascribed. When added to common air in the proportion of 1-9000th or 1-10,000th part, that gas sensibly affected the leaves of growing plants in ten or twelve hours, and killed them in forty-eight hours or less. The effects of hydrochloric or muriatic acid gas were still more powerful, it being found that the tenth part of a cubic inch, in 20,000 volumes of air, manifested its action in a few hours, and entirely destroyed the plant in two days. Both these gases acted on the leaves, affecting more or less their colour, and withering or crisping their texture, so that a gentle touch caused their separation from the

foot-stalk ; and both exerted this injurious operation, when present in such minute proportions as to be wholly inappreciable by the animal senses.

“ After having suffered much injury from these acid gases, the plants, if removed in time, will recover, but with the loss of their leaves. Hence, in vegetation carried on in smoky atmospheres, the plants are rarely killed altogether, but merely blighted for a season. Accordingly, in spring, vegetation recommences with its accustomed luxuriance, and as in many situations there is, at that season, and during the summer, a considerable diminution in the number of coal fires, there will be a proportionate decrease in the production of sulphurous acid gas ; and, consequently, less injury will be done to plants during that season. In winter, too, when coal fires mostly abound, and gas is most abundantly generated, deciduous plants are protected from its noxious operation by suspension of their vegetating powers ; but the leaves of evergreens, which continue to grow through that season, are constantly exposed to its action when present in its greatest intensity. Accordingly, in many of the suburban districts round London, especially in the course of the river where new manufactories are constantly rising up, the atmo-

sphere is so highly charged with noxious matters, that many deciduous plants and almost all evergreens cease to flourish, or exhibit only a sickly vegetation.

“ In an interesting biographical sketch of his lamented friend, Dr. Turner, Professor Christison confirms, by subsequent experience, the opinion formerly given respecting the noxious operation of the sulphurous or muriatic acid gas upon plants. He describes their action as so energetic, that, in the course of two days, the whole vegetation of various species of plants may be destroyed by quantities so minute as to be altogether inappreciable by the senses. On two occasions he was able to trace the identical effects of the same kind of works (the black ash manufactory) on the great scale, which his friends and himself witnessed in their researches. In one instance, the devastation committed was enormous, vegetation being, for the most part, miserably stunted, or altogether blasted, to a distance of fully a third of a mile from the works, in the prevailing direction of the wind. Against the evils arising from such a vitiated atmosphere, the plan of Mr. Ward provides effectual protection, as the success of his own establishment amply demonstrates.”

I believe, that there does not generally exist

in the atmosphere of London such a proportion of noxious gases as sensibly to affect vegetation, since we find geraniums and many other plants growing well without crisping or curling of their leaves, in the windows of shops and small houses, provided care be taken to keep the plants clean and free from soot. In the closed cases direct contact with any current of noxious gases is prevented, and the action of the law which regulates the diffusion of gases prevents the admission of such quantities of any noxious gas as might be injurious to the plants.

As this is a subject of the highest importance to the well-being of everything that has life, whether vegetable or animal, it will be well to give a full explanation of the above mentioned diffusion law—a law constantly in operation under all circumstances, and without the beneficent operation of which vegetable as well as animal life would suffer greatly in large towns, and a cellar in St. Giles' would quickly become a *grotto del cane*.

“If we take two vessels, and fill one with carbonic acid gas, and the other with hydrogen (their weights respectively being as twenty-two to one), and then place the light gas perpendicularly over the other, effecting a communication between the vessels by means of a tube not larger in

diameter than a human hair, the two gases will immediately begin to mix, and after a short interval will be found equally distributed between both vessels. If the upper vessel be filled with oxygen, nitrogen, or any other gas, the same phenomena will ensue; the gases will be found, after a short time, to be in a state of mixture, and at last there will be equal portions of each in both vessels. The permeability of animal membranes by gases has been fully proved by the researches of Drs. Faust and Mitchell. It fully appears from their experiments that animal membranes, both in the living and dead subject, both in and out of the body, are freely penetrated by gaseous matter; that the phenomena of endosmose and exosmose, observed in liquids by Duetrochet, are likewise exhibited by gases. If a glass full of carbonic acid be closed by an animal membrane, or sheet of caoutchouc, and be then exposed to the atmosphere, a portion of air will pass into the glass and some of the confined gas escape from it; and if the experiment be reversed by confining air in the glass, which is then placed in an atmosphere of carbonic acid, the latter passes in and the former out of the glass. Similar phenomena ensue with other gases; so that when any two gases are separated by a membrane, both of them pass through the partition. But though

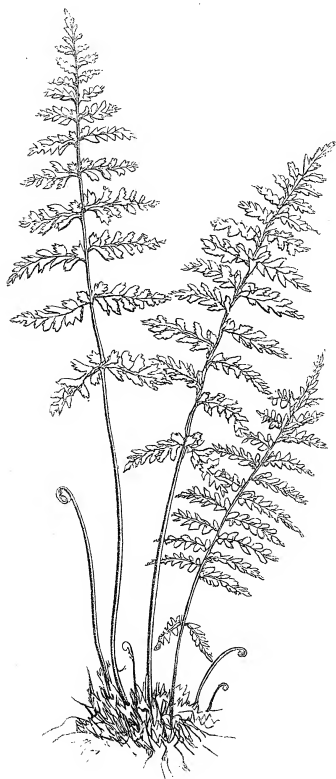
all gases pass through membranous septa, they differ remarkably in the relative rapidity of transmission. Thus, while a volume of carbonic acid requires five and a half minutes to pass through a membrane, the same volume of oxygen requires one hundred and thirteen, and a much greater time is required for nitrogen. Hence, when a bladder full of air is surrounded by carbonic acid, the latter enters faster than the former escapes, and the bladder bursts; but on reversing the conditions of the experiment, the bladder becomes flaccid, because the carbonic acid within passes out more rapidly than the exterior air enters. The transmission of gases in some of these experiments takes place in opposition to a pressure equal to several atmospheres."

To conclude this curious subject, Spallanzani proved that some animals possessed of lungs,—such as serpents, lizards, and frogs,—produce the same changes on the air by means of their skin, as by their proper respiratory organs; and Dr. Edwards, in a series of masterly experiments, has shown that this function compensates so fully for the want of respiration by the lungs, as to enable these animals, in the winter season, to live for an almost unlimited period under the surface of the water.

"It is scarcely possible," says Professor Daniel,

“duly to appreciate, in the vast economy of terrestrial adaptations, the importance of this mechanism, by which gases and vapours rapidly permeate each other’s bulks, and become equally diffused. The atmosphere which surrounds the globe consists of a mixture of several aeriform fluids, in certain fixed proportions, upon the proper maintenance of which, by measure and by weight, the welfare of the whole organic creation depends. The processes of respiration and of combustion are perpetually tending to the destruction of the vital air, and the substitution of another which is a deadly poison to animal life; and yet, by the simple means which we have described, the poisonous air is not allowed to accumulate, but diffuses itself instantly through surrounding space, while the vital gas rushes, by a counter tendency, to supply the deficiency which the local consumption has created. Hence the invariable uniformity of this mixture, which is one of the most surprising phenomena in a system where all is admirable. The most accurate examination has been made of air which has been taken from localities the most opposed to each other in all the circumstances which can be conceived to affect its purity; by means of a balloon, from a height of 22,000 feet above the level of the sea; from the surface of the ocean;

from the summit of Mont Blanc ; from the heart of the most crowded districts of the most populous cities ; from within the polar circle ; and from the equator ; and no difference has been detected in the proportions of its principal constituents."



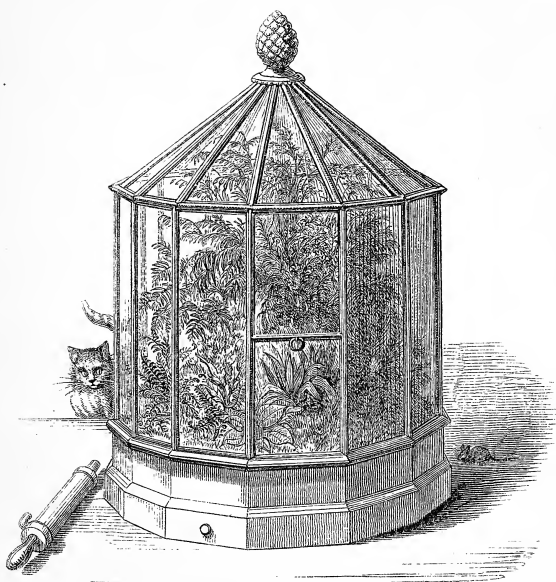
CHAPTER III.

ON THE IMITATION OF THE NATURAL CONDI-
TIONS OF PLANTS IN CLOSELY
GLAZED CASES.

Nature does not allow herself to be forced or drawn. You must follow her, not she you.—PARACELSUS.

Homo, Naturæ minister et interpres, tantum facit et intelligit quantum de Naturæ ordine re vel mente conservaverit; nec amplius scit aut potest.—BACON.

The power of man over Nature is limited only by the one condition, that it must be exercised in conformity with the laws of Nature.—HERSCHEL.



ON THE IMITATION OF THE NATURAL CONDITIONS
OF PLANTS IN CLOSELY GLAZED CASES.

THE science of Botany, in consequence of the perusal of the works of the immortal Linnæus, had been my recreation from my youth up, and the earliest object of my ambition was to possess an old wall covered with ferns and mosses. To

obtain this end, I built up some rock-work in the yard at the back of my house, and placed a perforated pipe at the top, from which water trickled on the plants beneath; these consisted of *Polypodium vulgare*, *Lomaria Spicant*, *Lastræa dilatata*, *L. Filix mas*, *Athyrium Filix fœmina*, *Asplenium Trichomanes* and a few other ferns, and several mosses procured from the woods in the neighbourhood of London, together with primroses, wood-sorrel, &c. In consequence, however, of the volumes of smoke issuing from surrounding manufactories, my plants soon began to decline, and ultimately perished, all my endeavours to keep them alive proving fruitless.

When the attempt had been given up in despair, a fresh impetus was given to my pursuits, and I was led to reflect a little more deeply upon the subject, in consequence of a simple incident which occurred in the summer of 1829. I had buried the chrysalis of a sphinx in some moist mould contained in a wide-mouthed glass bottle, covered with a lid. In watching the bottle from day to day, I observed that the moisture which, during the heat of the day arose from the mould, condensed on the surface of the glass, and returned whence it came; thus keeping the earth always in the same degree of humidity. About a week prior to the final change of the insect,

a seedling fern and a grass made their appearance on the surface of the mould.

I could not but be struck with the circumstance of one of that very tribe of plants which I had for years fruitlessly attempted to cultivate, coming up *sponte sua* in such a situation, and asked myself seriously what were the conditions necessary for its well-being? To this the reply was—a *moist atmosphere free from soot or other extraneous particles; light; heat; moisture; periods of rest; and change of air*. All these my plant had; *the circulation of air* being obtained by the diffusion law already described.

Thus, then, *all the conditions* requisite for the growth of my fern were apparently fulfilled, and it remained only to test the fact by experiment. I placed the bottle outside the window of my study, a room with a northern aspect, and to my great delight the plants continued to thrive. They turned out to be *L. Filix mas* and the *Poa annua*. They required no attention of any kind, and there they remained for nearly four years, the grass once flowering, and the fern producing three or four fronds annually. At the end of this time they accidentally perished, during my absence from home, in consequence of the rusting of the lid, and the consequent too free admission of rain water. Long before this occurred, how-

ever, I procured for the purpose of experiment some plants of *Trichomanes* and *Hymenophyllum*, and perhaps the most instructive way in which I can communicate the results of my experiments will be to select a few out of numberless experiments, in the order in which they occurred. To commence with—

1. *Trichomanes radicans* or *speciosum*.—I was induced to commence with this, the most lovely of our cellular plants, in consequence of its being the most intractable under ordinary methods of culture—of its being, in fact, the *opprobrium hortulanorum*. Loddiges, who had it repeatedly, never could keep it alive; and Baron Fischer, the superintendent of the botanical establishments of the Emperor of Russia, when he saw the plant growing in one of my cases, took off his hat, made a low bow to it, and said, “You have been my master all the days of my life.” Whence then arises the great difficulty of cultivating this plant? It is simply owing to the occasional dryness of the atmosphere, and the presence of adventitious matters. Place the plant in one of my cases, where it has a constantly pure and humid atmosphere, and it will grow as well in the most smoky parts of London, as on the rocks at Killarney, or the laurel forests of Teneriffe—

“Miraturque novas frondes.”

This plant lived for about four years in a wide-mouthed bottle, covered with oiled silk, during which time it required no water, but having outgrown its narrow bounds it was removed to some rock-work in my largest fern-house, covered with a bell-glass, and occasionally watered. Here it produced fronds fifteen inches in height by seven or eight in breadth, one-fourth larger than native specimens, either from Killarney, or elsewhere. I have lately seen specimens of this beautiful plant in St. Paul's Church Yard, Broad Street Buildings, and other places in London, which are quite equal to any I have seen in Ireland, and one fine bushy plant at Kensington, now containing eighteen or twenty fronds, which was sent by post from Dublin two years since, and then consisted of a small portion of rhizome with three fronds only.

The finest specimen, however, of *Trichomanes* in cultivation, of which I have any cognizance, is one in the possession of R. Callwell, Esq., of Dublin, whose account is so interesting that I copy it *verbatim* :—

DUBLIN, 3rd August, 1852.

MY DEAR SIR,

At the request of our mutual and very esteemed friend, Dr. Wm. Harvey, I have the

pleasure of sending you some particulars of the plant of *Trichomanes* in my possession.

In the spring of 1843, I received a small portion of the *rhizome*, about five or six inches long, with one frond partially developed, and one other just appearing, which I placed in a bell-glass about fifteen inches diameter. In December, 1846, it quite filled the glass, and in that month I removed it into a case 3 feet 10 inches by 2 feet 6 inches, and 3 feet 4 inches in height—the space under this, about twelve inches in depth, was filled with upturned flower-pots, charcoal, cocoa-nut husks, and light earth and peat. The plant now nearly fills this case. It is difficult to count the fronds accurately, but, as nearly as I can count them, they number two hundred and thirty or upwards, of fully-developed fronds; the length of the fully-opened fronds being from fourteen to twenty and a-half inches, taking the length from the end of the stem, where it starts from the *rhizome*, to the point of the frond. When removing it to the present case, in Dec. 1846, I cut away five or six fronds which had been injured by contact with the glass, but since that time not one of the fronds then existing, nor any of those since formed, have shown any symptoms of decay. As to the general treatment, having originally provided well

for perfect drainage, I carefully sprinkle the surface of the fronds with water once or twice a week in summer, and less frequently in winter, and keep the door of the case (which is very close) always shut, the drainage-valve underneath always open. The case stands in a vestibule with nearly west aspect, quite sheltered from the south by the house, which is much higher than the vestibule. I strongly think that much of my success is due to the fact that the light is much subdued by shining through coloured glass windows (the colour is chiefly brown and orange). The general appearance of the plant is quite natural, the fronds bending down mostly. About three years ago, I placed, for experiment, a small portion of the *rhizome* with one open frond, on a block, and hung it up in the case. It has now nineteen expanded fronds, varying from nine to twelve inches in length, the *rhizome* having crept all round the block, and throwing down abundance of roots five or six inches long. I have not found any other fern to thrive, or even to live, in this case, except *Asplenium marinum*, which seems to like the situation tolerably. I have even tried *Hymenophyllum Tunbrigense* and *Wilsoni*, neither of which lived past one year. The plant has never shown the least approach towards producing seeds, although I

have seen many plants taken from the same locality (Turk's Waterfall, Co. Kerry), which have fructified profusely.

I remain, my dear Sir,

Yours very respectfully,

ROB. CALLWELL.

The above communication suggests one or two reflections of practical application. We see, first, how possible it is to grow some plants in closed cases, in even more than their native luxuriance. I believe it would be very difficult, if not impossible, to find such a patch of *Trichomanes* as is above described, either in Ireland or in any part of the world. The next reflection is, that, in obedience to well-known physiological laws, whenever the foliage of a plant is developed to a greater extent than usual, the tendency to produce fruit becomes proportionally diminished, and sometimes, as in the above instance, ceases altogether—not one frond out of the two hundred and thirty fructifying. It would be interesting to watch the effect of exposure to stronger light, and of a diminished supply of water. We further learn that ferns, like other plants, vary much as to their natural states, and that, in order to grow even the British ferns in *one* case, it will be necessary to pay attention to their

respective wants ; and, before I proceed in my narrative, I may as well describe how this is to be effected.

House in which all the British ferns may be grown :—

“ Where the tall foxglove peeps into the brook,
And royal ferns adorn each watery nook.”

In order to grow all our ferns under one roof, it would, of course, be necessary to fulfil their varying conditions of growth, and this might be easily effected by building a model of some antique ruin, or by imitating some mountainous ravine, or other bit of natural scenery with water trickling down from the elevated portion of the rock, and flowing out of the house in a continuous stream at the bottom. In such a house, without any artificial heat, our ferns would attain a luxuriant growth, unimaginable by those who know them only under ordinary circumstances. Each fern could be supplied with a proper base of earth or rock, and each could have the amount of light most suited to its fullest development. The *Trichomanes* might there revel on its Turk rock, and gladden the eyes of the beholder with its lovely fronds spangled with iridescent rain-drops : at the base of the rock and extending to the margins of the central brook, the two species of *Hymenophyllum*, with *Blechnum boreale*, *Lastræa*

Thelypteris, and the lovely *lady-fern* would luxuriate; whilst on the borders of the little brook or in the centre of the water, the royal *Osmunda* would raise itself to the height of ten or twelve feet, as if conscious of its sovereignty, and worthy of the admiration elicited from Sir Walter Scott, when visiting the Lakes of Killarney. One or two chalk or sandstone caves might be lined internally with the *Asplenium marinum*, its massive dark green and glossy leaves beautifully contrasting with the light and elegant foliage of the *maidenhair* growing on the top. In the more elevated portions, and fully exposed to light, *Allosorus crispus*, *Cistopteris fragilis*, and the other species and varieties would thrive (with the exception of the rare *Cistopteris montana*, which should be planted in reach of the spray), as would *Asplenium septentrionale*, and the *Wood-sias*; whilst every chink and crevice might be occupied with *Polypodium Dryopteris*, *P. calcareum*, *P. Phlegopteris*, *Asplenium Trichomanes*, *Adiantum nigrum*, *lanciolatum*, &c. Such a house might be made very useful in determining those varieties of ferns which depend upon varying climatal differences, and in limiting the multiplication of species which now appears to be increasing rather too rapidly. A great number of the more beautiful or rare British flowering

plants might be intermixed with the ferns, and would add greatly to the effect of the whole, taking especial care that each should have the amount of *light* and *moisture* which it obtains in its natural state.

So much for British ferns and plants; but the time will most assuredly come when those citizens of London who now recreate and refresh their souls with such a house as is above described, will raise their desires to the possession of equally beautiful, but much more noble and majestic forms: I mean, particularly, those of the *Tree ferns*. We are told by Humboldt, that between the Tropics, on the declivities of the Cordilleras, the proper zone of the Tree ferns is between 3200 and 5330 feet above the level of the sea. In South America and the Mexican Highlands, they seldom descend lower than 1200 feet. The mean temperature of this happy zone is between 70·2 and 64·6 Fahr. This region enters the lowest stratum of clouds, or that which floats next above the sea and the plains; and hence, besides great equality of temperature, it enjoys, uninterruptedly, a high degree of humidity. The conditions of mild temperature and an atmosphere nearly saturated with vapour, are fulfilled on the declivities of the mountains in the valleys of the Andes, and, above all, in the mild and humid

atmosphere of the Southern hemisphere, where arborescent ferns extend, not only to New Zealand and Van Dieman's Land, but even to the Straits of Magellan, and to Campbell Islands, or to a latitude almost corresponding to that of Berlin in the Northern hemisphere.

Nothing would be easier than to fulfil the above conditions in the court-yards of London. For the growth of ferns generally, it would, most probably, be advantageous to glaze the houses with the tinted glass recommended by Mr. Hunt, and used in the great Palm-house at Kew. It might likewise be requisite to use blinds in hot weather. In any such large house, filled with British or Tropical forms of vegetation, fish and birds, and other animals, might be introduced to enliven the scene.

To return to the *Trichomanes*: the mode of planting, which I had previously adopted, had been to secure it firmly on sandstone or other porous stone (upon pieces of which it delights to grow), and to fill the interspaces with about equal portions of white sand and peat earth. I should now, however, follow the plan recommended by Mr. Callwell. The species of *Hymenophyllum*, upon which I next experimented, require to be treated in a similar manner, and to be liberally supplied with water. Neither the *Trichomanes* nor the

Hymenophylla require much sun. This will be a fitting place to make mention of a small but most interesting bottle which I received in October 1837, from Mr. Newman, superintendent of the Botanic Garden in the Mauritius. The bottle was filled with two or three specimens of a small species of *Gratiola*, and of *Cotala*, and lightly covered with painted canvas. The plants were in full flower. I placed them in a window with a southern aspect: they remained in vigour for six or seven weeks, when they successively declined and perished without ripening any seed, in consequence of the too great humidity of the soil. Before this took place, I observed, as in my first experiment, several seedling ferns making their appearance between the mould and the side of the glass, and therefore allowed the bottle to remain in the same situation, which it has occupied to the present time, the covers having been twice renewed in consequence of decay. It is now a very interesting object. The upper part is filled with fronds of two species of *Adiantum*, and the lateral surface of the mould is coated with seedling ferns in all stages.

We may learn a few useful lessons from this little bottle. We see how abundant the seeds of ferns are, and how easy it would be to obtain many species from distant countries by collecting

from various localities a handful of the surface mould, and, at any convenient season, placing this in a situation favourable for their growth. To those cavillers, who are continually questioning me as to the utility of ferns in creation, I answer that one of the useful purposes which they serve, in common with other cellular plants, is that of providing mould in situations where plants of a higher order could not at first grow; and this is effected in a twofold manner—by the decay of their fronds, and the action of their roots. Mr. Webster, in his account of the voyage of the “Chanticleer,” states, that in the course of his ramble in the Island of St. Catherine, when gathering ferns, he was particularly struck by observing that each plant had formed for itself a bed of fine mould, several inches in depth and extent, whilst beyond the circle of its own immediate growth was naked rock: and this appeared so general that he could not help attributing the extraordinary circumstance to the disintegrating power of their fibrous roots, which penetrated every crevice of the rock, and by expanding in growth, appeared to split it into the smallest fragments.* Ferns, likewise, are of the greatest

* The *Opuntia*, or prickly pear, when planted in fresh fields of lava, which, in the ordinary course of nature—*i.e.* by the successive growth and decay of lichens, mosses, and other cellular plants, would require a thousand years to become fertile, renders them capable of

service to man, affording him in various countries supplies of food in time of need, and giving protection to numberless animals upon which man subsists. Nor is this all—I would fain hope that the words of the poet will not apply to any of my readers—

“ In vain, through every changeful year,
 Did Nature lead him as before,
 The primrose on the river’s brim,
 A yellow primrose was to him,
 And it was nothing more.”

In tropical countries the arborescent ferns are the most glorious objects in the vegetable kingdom; and in temperate climes that man is little to be envied who cannot take delight in the phoenix-like beauty thrown over dead and decaying works of Nature and Art by these lovely forms, nor be led by these visible things of creation to adore the invisible wisdom and admirable workmanship of Almighty God.

But to return from this digression. Having determined the complete success of this mode upon more than a hundred species of ferns, and

being converted into vineyards in the course of thirty or forty; and this by the comminuting action of its roots. Succulent plants are admirably adapted for such an office in hot and dry countries, where rain is of unfrequent occurrence, in consequence of their structure, which enables them to take in very readily moisture from dews or rain, but prevents evaporation during long-continued droughts.

my ideas having a little expanded, I built a small house about eight feet square, outside one of my staircase-windows, facing the north; and proceeding from ferns to those plants with which they are associated, filled it with a mixed vegetation. This was called—

The Tintern Abbey House,* from its containing in the centre a small model, built in pumice and Bath stone, of the west window of Tintern Abbey. The sides were built up with rock work to the height of about five feet, and a perforated pipe passed round the top of the house, by means of which I could rain upon the plants at pleasure. In the middle of summer the sun shone into this house for about an hour early in the morning, and about the same time in the evening, but not at all during the winter. There was no artificial heat. I planted in it about fifty species of British, North American, and other hardy ferns—one or two *Lycopodiums*, and the following flowering plants, viz. *Linnæa borealis*, *Oxalis acetosella*, *Primula vulgaris*, *Digitalis purpurea*, *Cardamine flexuosa*, *Lonicera periclymenum*, *Meconopsis Cambrica*, *Geranium Robertianum* v. *fl. albo*, *Dentaria bulbifera*, *Paris quadrifolia*, *Mimulus moschatus*, *Linaria Cymbalaria*, *Convallaria multiflora*, *C. Polygonatum*, *Lamium maculatum*, and several

* Vide Frontispiece.

others. All these flowered well, but the atmosphere was too moist, and there was too little sun for them to ripen seed, with the exception of the *Mimulus*, the *Oxalis*, and the *Cardamine*, which latter grew with great luxuriance, and furnished throughout the year a most grateful addition to the food of a tame Canary-bird. The *Rhapis flabelliformis* and *Phoenix dactylifera* bore the cold during three winters in this house, when I was obliged to remove them in consequence of their size. A double white *Camellia* flowered well for three successive springs, but was killed by the severity of the following winter. In a cold house like this, but with an eastern or western aspect, so as to admit more solar light, I believe that *Camellias* would thrive luxuriantly and be far less likely to suffer from the winter's cold. The influence of light in enabling plants to withstand cold is far too little attended to, and in most cases where it is necessary to protect delicate plants in winter, light should be admitted, if possible.

I shall next mention *The Alpine Case*:—*Azalea procumbens*, *Andromeda tetragona* and *hypnoides*, *Primula minima*, *P. Helvetica*, *Soldanell amontana*, *S. Alpina*, *Eriophorum Alpinum*, and a few others, were the contents of my first Alpine case. As I thought there would not be sufficient light at

any of my windows, I placed the case on the roof of the house, and in the following spring, all the plants flowered well except the *Andromedas*. Forgetting that an Alpine summer is not so long as ours, I allowed the plants to remain fully exposed to the sun for the whole year, owing to which they became so exhausted that some died, and but few flowered in the ensuing spring. Warned by this, in my succeeding experiments on this lovely tribe of plants, I removed the case, after their flowering, into the coldest and most shady place I could find until the following season, when they were again placed in the sun. In this way they flourished better; but it is impossible to do them full justice, as we cannot give them the perfect rest which they require.

The Drawing-room case contains the Date Palm and the *Rhapis flabelliformis*, with two or three *Lycopodiums* and Ferns. Several bulbous roots are planted in this case annually, as it stands in a window with a southern aspect. Within, along the roof, runs a perforated bronze bar, from which are suspended small pots, containing various species of Aloe and Cactus. In this way it is easy to grow bog plants and succulents in the same case, as these last never receive any water but in the state of vapour,

which is most abundant when they most need it, *i.e.* in the heat of summer.

The palms have *now* been enclosed for fifteen years, and owing to the confined state of their roots, they will continue for very many years without outgrowing their narrow bounds.

Crocuses and Winter Aconites.—Two cases were filled with these plants; the one placed *outside* a window with a southern aspect, where there was sufficient light, but no artificial heat; the other in a *warm* room, where the light was very deficient. The plants in the former case exhibited a perfectly natural appearance, and the flowers were abundant and well-coloured; whilst in the latter, the leaves were very long and pale, and not a single flower was produced.

Crocuses with artificial light.—A case, fitted up precisely as the two preceding, was placed on my staircase, close to a gas lamp. The plants were covered during the day with a thick dark cloth, so as effectually to exclude daylight, and as soon as the gas was lighted, the cloth was removed. The plants were thus exposed from five to eight hours daily to the influence of artificial light, accompanied by some increased degree of heat, while the remainder of the twenty-four hours was spent in a state of rest. The plants grew well, the leaves not so much drawn

as those in the warm room, and the colour more intense. One root flowered, the colour of the flower being blue.

Case with Spring flowers.—In order to have a gay assemblage of flowers, I filled a case about three feet by one, with the following plants, viz., *Primula Sinensis*, *P. nivalis*, *Scilla Siberica*, *Cyclamen Coum*, *Ornithogalum Steinbergii*, *Gagea lutea*, *Ganymedes pulchellus*, and three or four varieties of *Crocus*, interspersed with little patches of *Lycopodium denticulatum*. The case was placed, about the end of February, outside a window with a southern aspect. It is not, I believe, possible to see these plants to such advantage in any ordinary garden. Here, undisturbed either by wind or by rain, their flowers were developed in the greatest luxuriance, and lasted for a much longer period, realising the beautiful description of Catullus :—

Ut flos in septis secretus nascitur hortis,
 Ignotus pecori, nullo contusus aratro,
 Quem mulcent auræ, firmat sol, educat imber—
 Multi illum pueri, multæ optavere puellæ.

Fairy Roses, when planted in a tub and covered with a bell-glass of rather smaller diameter than the tub, so as to allow the rain which falls to run through the mould, without touching the plant, succeed most admirably when placed in a

full southern exposure. They generally flower four or five months in every year, the only attention which they require, being to prune them after each flowering.

It would be waste of time to detail any more of these minor experiments, and I shall, therefore, now describe the largest experimental house which I fitted up in Wellclose Square. The object which I had in view was to obtain as many varied modifications of the natural conditions of plants as it was possible to procure in the small space to which I was confined.

The length was twenty-four feet, width twelve, and extreme height eleven feet. Over the door was this line:—

“*Exiguus spatio, variis sed fertilis herbis,*”

which may be thus translated—

“You scarce upon the borders enter,
Before you're in the very centre;
Yet, in this narrow compass, we
Observe a vast variety.”

By building up rock-work to within a foot of the glass, and by varying the surface in every possible way, very different degrees of heat, light, and moisture, were obtained to suit the varying wants of the plants. The house was heated in winter by means of hot-water pipes which preserved the lower portion during that season at

a much higher temperature than the upper part : the latter, however, had the advantage in the height of summer. There was no sunshine from the end of October to the end of March. The range of the thermometer throughout the year in the lowest part was between 45° and 90° , whilst at the top it was between 30° and 130° . Thus was procured, in a space not exceeding ten feet, an insular, and what may be called, an excessive climate. In the lower region were planted the following Palms :—*Phoenix dactylifera*, *P. leonensis*, *Rhapis flabelliformis*, *R. Sierotzik*, a small but lovely species from Japan, *Chamærops humilis*, *Seaforthia nobilis*, *Cocos botryophora*, *Corypha australis*, *Latania Borbonica*, and one or two others.

Of *Ferns* more than one hundred species were planted, and amongst these the *Asplenium præmorsum* grew remarkably fine, each frond lasting three or four years : the *Callipteris elegans* (the *Diplazium Seramporensis* of gardens), which had been sterile at Loddiges' for more than fifty years, produced a frond covered with fructification, the *Didymochlæna pulcherrima*, and last, but not least, the *Trichomanes speciosum*. Of *Scitamineous* plants, of which there were ten or a dozen species, the *Calathea zebrina* was the most conspicuous. The *Caladium esculentum*, and numerous other

plants which do not require much sun, likewise grew in this part of the house. In the upper regions were numerous species of *Aloë*, *Cactus*, *Bilbergia*, *Begonia*, &c. Two or three varieties of rose likewise flowered here, but neither so well nor so freely as in the cases already described. In hot summers the *sensitive plant* (*Mimosa pudica*) flowered freely, as did one or two species of *Passion-flower*. In the intermediate spaces were *Disandra prostrata*, *Fuchsias*, and various other plants. From the roof were suspended numerous succulents, and *Orchideous epiphytes*, but the temperature fell too low in the winter, and rarely rose sufficiently high for these '*splendid things without a foundation*,'* so that they seldom flowered.

In addition to this great variety of living forms, there was a large and fine collection of antediluvian plants, species of *Lepidodendron*, *Calamites*, &c., which, when compared with their recent types, the *Lycopodia*, *Equiseta*, &c., are truly

“Of aspect that appears
Beyond the range of vegetative power.”

Aquarium for fish and plants.—I commenced my experiments on fish and plants about ten years ago, in a large earthen vessel, given to me for the purpose by my friend Mr. Alfred White. This

* The meaning of the name given to them by the South Sea Islanders.—*Williams*.

vessel contained twenty gallons of water, and in it I placed ten or twelve gold and silver fish, in company with several aquatic plants, viz. *Valisneria spiralis*, *Pontederia crassipes*, *Papyrus elegans*, and *Pistia Stratiotes*, which plants, by means of their vital actions, as had long been well known, maintained the purity of the water, and, as in the atmosphere, kept up the balance between the animal and vegetable respirations. Placed in the centre of my fern-house and nearly surrounded by rock work (rising five or six feet above the margin of the vessel, clothed with *Adiantum* and other lovely ferns, and partially overshadowed with the palmate leaves of *Corypha australis*, the plants and fish continued to flourish for years, prior to their removal to Clapham in 1848. The only enemy I had to contend with was a species of *Vaucheria*, which, from its rapid growth, required to be kept constantly in check. My friend, Mr. Bowerbank, always alive to scientific inquiries, followed up these experiments with equal success, but substituted stickle-backs and minnows for the gold fish.*

The plants were removed about three years and a half ago, from the case just described, to a house prepared for them at my new abode at Clapham.

* Mr. Warrington, who subsequently experimented upon the same subject, states that he found it necessary to introduce a few snails (*Limeus stagnalis*) to get rid of a slime produced by the decaying leaves of *Valisneria spiralis*.

Here I possess far greater capabilities for the growth of plants than in the old locality where, for five winter months, not a ray of solar light entered; and, during the summer months, the larger portion of sun-light was intercepted. *Here* there is nothing to obstruct the rays of the sun, from its rising to its setting; and, consequently, I am enabled to grow and to flower a much larger portion of tropical plants than before. This house is heated during the winter months by hot water pipes, and care is taken that the thermometer does not fall below 44° , that being the minimum temperature which the banana will bear. The maximum temperature, without sun, is about 85° . The temperature even in the middle of December, on a bright sun-shiny day, rises to 95° or 100° , and in summer to 130° , so that I am compelled, occasionally, to use blinds. In this house, having an unlimited command of sun, I have endeavoured to imitate, in miniature of course, a tropical forest.* The ground was prepared for the reception of the plants, by first covering the

* Humboldt has remarked "How interesting and instructive to the landscape painter would be a work which should present to the eye, in combination and contrast, the leading forms of tropical vegetation. How interesting the aspect of tree-ferns spreading their delicate fronds above the laurel-oaks of Mexico, or groups of bananas overshadowed by arborescent grasses." With how much greater force do these remarks apply to the cultivator of plants.

natural gravelly soil of the garden with two or three cart-loads of old brick rubbish, and upon this porous material, three or four loads of light sandy peat, giving loam to those plants which required it. In addition to the plants mentioned above as inmates of the old house in town, are three species of *Musa*, *M. Cavendishii*, *M. Chinnensis*, and *M. bicolor*, *Canna edulis*, *C. indica*, *C. gigantea*, and one or two others: *Stephanotus floribundus*, *Clerodendron squamatum*, *Hibiscus Manihot*, *Passiflora quadrangularis*, *P. alæformis*, *P. princeps*, *Jasminum Sanbac*, with single and double flowers; *Hoya carnosæ*, *H. Cunninghamii*, *Serico-graphis Ghibertiana*, three or four fine species of *Justicia* and *Eranthemum*; many species and varieties of *Achimenes*, *Gesneria* and *Gloxima*, *Aristolochia trilobata*, *Bambusa nigra*, &c. All these, with the exception of the Bamboo, flower most beautifully, and many of them ripen their seeds.

The difference of climate in this house, when compared with the old locality, is strikingly manifested in several plants which, although inmates for years, never flowered in town, but *here* do so annually. Amongst these are the *Strelitzia Regina*, *Caladium esculentum*, &c. I have not a doubt that many edible fruits would succeed in such a house. A gentleman from Shropshire once wrote me word, that he had

gathered a fine crop of grapes in a closed house, and by adopting the plan mentioned in a former part of this work, as practised in Ceylon, of laying bare the roots, so as to cause the leaves to fall off, and thereby give the plant rest, such crops of fruit would, most probably, be insured.

My pool of water in this house is much larger than in the former, containing about two hundred gallons. Here the fish luxuriate amidst *Anacharis Alsinastrum*, *Pontederia crassipes*, *Pistia Stratiotes*, *Villarsia reniformis*, and other aquatics.

I have thus described, imperfectly indeed, some of the results attainable in a temperate climate, and there cannot be a doubt, that in *dry* tropical countries the application of the same plan might be equally striking and beneficial. In ordinary horticulture much is effected by closely imitating the natural conditions of plants. Thus, my friend Dr. Royle, who has paid especial attention to this subject, informed me that there were certain plants in his garden, at Saharanpore, which he could only keep alive by surrounding them with small trees and shrubs, so as to give them a moister atmosphere than they could otherwise have obtained; and he mentions in his beautiful work, the "Illustrations of the Flora and Fauna of the

Himalayas," a striking example of this kind. "To show the effects of protection and culture, *Xanthochymus dulcis* may be adduced as a remarkable instance. This tree, which is found only in the southern parts of India, and which would not live in the more exposed climate of Saharanpore, exists as a large tree in the garden of the King of Delhi; but here, surrounded by the numerous buildings within the lofty palace wall, in the midst of almost a forest of trees, with perpetual irrigation from a branch of the canal which flows through the garden, an artificial climate is produced, which enables a plant even so sensible of cold as one of the *Guttiferæ*, to flourish in the open air of Delhi, where it is highly prized, and reported to have milk thrown over its roots, as well as its fruit protected from plunder by a guard of soldiers." The comparative stillness of the atmosphere surrounding a plant thus sheltered, has, doubtless, its effect in enabling it to bear the cold. Supposing ourselves in a hot and dry country, let us see what may be done by surrounding our plants with glass, and lowering the temperature, if requisite, by means of the evaporation of water from the external surface. We shall be enabled in this manner, as with the wand of a magician, to turn a desert into a paradise. Such *cases* cannot be better described than by

the beautiful description of the palm groves given by Desfontaines in his "Flora Atlantica."

"These palm-groves, being impervious to the sun's rays, afford a hospitable shade both to man and other animals, in a region which would otherwise be intolerable from the intense heat. And under this shelter, the orange, the lemon, the pomegranate, the olive, the almond and the vine grow in wild luxuriance, producing, notwithstanding they are so shaded, the most delicious fruit. And here, while the eyes are fed with the endless variety of flowers which deck these sylvan scenes, the ears are at the same time ravished with the melodious notes of numerous birds, which are attracted to these groves by the cool springs and the food which they there find."

There are many other situations where these cases would be useful, as on ship-board, or where there exists a necessity for economizing water, as in the island of Ascension.

In very *cold* countries too it is of great moment to make the best use of the little sun they possess, and to protect the plants from searching winds. The cabbages of Iceland and Labrador would surely exceed their present size of one or two inches in diameter, if thus protected.

As to the *cases* themselves — they admit of almost endless diversity of shape and size, from

a wide-mouthed quart bottle to a building as large as the Crystal Palace, the larger indeed the better. The earlier cases were rude and inelegant, when contrasted with those of my friend Mr. Cooke, who exerted his artistic taste in making them ornamental as well as useful. Many had the opportunity of seeing the difference when exhibited in Hyde Park, but drawings are added to enable all to choose for themselves.* It is always desirable to have an opening in the bottom, as some plants are the better for occasional watering, and in the event of slugs getting into the mould, they may be destroyed by washing the earth with lime-water, which has thus a means of escape. Many cellular and flowerless plants will go on for a very long period without any fresh supply of water. I have now a bottle which was in the Exhibition, containing a fern or two with some mosses, which are in perfect health, and yet have not received any fresh water for eighteen years, and I believe it would be quite possible to fill a case with Palms and Ferns (placing it in a position where it would always obtain sufficient light and heat) that would not require any water for fifty or a hundred years.

* A stand for ferns, manufactured in terra cotta, by Mr. Doulton, of Lambeth, is worthy of notice, the corners of the stand representing the *Lepidodendron*, and the sides ornamented with antediluvian ferns.

Numerous plants require to be well supplied with water up to the period of inflorescence, and when the flowering is over, to be kept nearly dry. This is easily effected by removing the lid, or opening the door of the case, and allowing the superfluous moisture to evaporate. It is a very common but erroneous impression, that great knowledge of botany is required before any successful attempts at the cultivation of plants in closed cases can be made; now, it must be obvious, from all that has been said, that whether the plant be grown in a case, or in the open air, its natural condition must be fulfilled to insure success. Again, many complain that the enclosed plants frequently become mouldy; this may arise either from cold, want of light, redundant moisture, or a combination of these causes, producing diminished vital action, or else from the natural decay of the plant. It is very interesting to watch the progress of this. The moment a plant begins to decay, it is no longer of any use; and the small parasitical fungi, commonly called moulds, are some of the means employed by Nature in removing that which would otherwise be an incumbrance,—“Cut it down, why cumbereth it the ground?”

To conclude this part of my subject with a few general observations. The advantages of the

close method of growing plants consist mainly in the power we possess of freeing or sifting the air from extraneous matters, of imitating the natural condition of all plants, as far as the climate we are living in will enable us to do, and of maintaining this condition for indefinite periods, free from disturbing causes. The plants are, of course, preserved from excess or deficiency of moisture, and owing to the perfectly quiet condition of the atmosphere with which they are surrounded, are able, like man, to bear extremes of temperature with impunity, which under ordinary exposure would destroy them. The experiments of Sir C. Blagden, and others, in heated ovens, are well known, and the performances of Chaubert are familiar to most of my readers. In these instances the immunity is owing to the aqueous exhalations from the surface of the body remaining undisturbed, and thus acting as a protecting shield. In like manner the *Trichomanes* lived for three years in a window with a southern aspect, exposed continually to a heat, which, without the protection afforded by the glass, would have destroyed it in a single day. With respect to *cold*, the concurrent testimony of all arctic voyagers proves, that no inconvenience is felt, provided the air be perfectly still, even if the thermometer

fall to 70° below zero ; but that, if wind arise although the thermometer rise rapidly with it, the cold then becomes insupportable. These same voyagers acquaint us with an interesting fact, illustrating the truth of the old saying, that there is nothing new under the sun. Even the *closed cases* are as old as the creation. We are told, that the snow itself affords shelter to the productions of those inhospitable regions against the piercing winds that sweep over fields of everlasting ice. Under the cold defence of the snow plants spring up, dissolve the snow a few inches round, and the part above being again quickly frozen into a transparent sheet of ice, admits the sun's rays which warm and cherish the plant in this *natural hothouse*, until the returning summer renders such protection unnecessary. I need not, however, go to the Pole for illustrations of the effect of disturbed atmosphere in cold weather. One of our poets has said,—

“ And, with east winds, will teach you how to shave.”

All are familiar with our cutting March winds, which are so injurious and destructive to vegetation in the open air, but have no effect upon enclosed plants. With respect to change of air, the plants obtain all the change which they require, by virtue of the diffusion law already

explained, and no method of closing the cases can prevent this from taking place.

A few words respecting the importance of reflecting on what we see around us, will with propriety close the chapter.*

The simple circumstance which set me to work must have been presented to the eyes of horticulturists thousands of times, but has passed unheeded in consequence of their disused closed frames being filled with weeds, instead of cucumbers and melons; and I am quite ready to confess that if some groundsel or chickweed had sprung up in my bottle instead of the fern, it might have made no impression upon me; and again, after my complete success with the ferns, had I possessed the inductive mind of a Davy or a Faraday, I should, in an hour's quiet reflexion, have anticipated the results of years. I should have concluded, that all plants would grow as well as the ferns, inasmuch as I possessed the power of modifying the conditions to the wants of each individual.

* I was once honoured by a visit from a celebrated mathematician, who called to make inquiry concerning the management of plants in closed cases, as *he* had succeeded with some, but failed with others. He left me with these words. "Come and see me. I can in some measure repay you in kind. I can make you do what you have made me do—*think*."

CHAPTER IV.

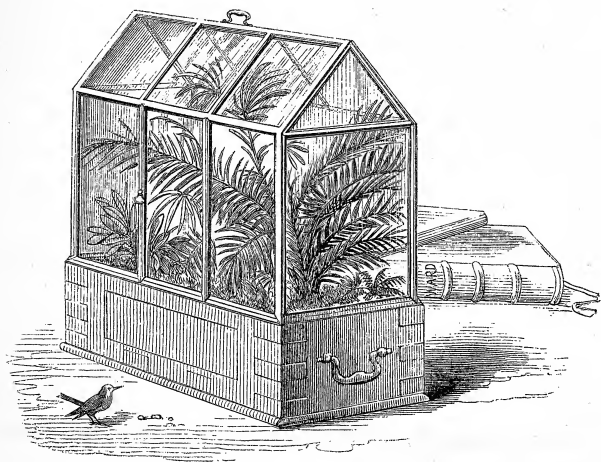
ON THE CONVEYANCE OF PLANTS AND SEEDS
ON SHIP-BOARD.

Inque novos soles audent se germina tuto
Credere; nec metuit surgentes pampinus austros,
Aut actum cœlo magnis aquilonibus imbrem ;
Sed trudit gemmas, et frondes explicat omnes.

VIRG. Geor. ii. 332.

. The golden boast
Of Portugal and Western India, there
The ruddier orange, and the paler lime,
Peep through their polished foliage at the storm,
And seem to smile at what they need not fear.

COWPER.



ON THE CONVEYANCE OF PLANTS AND SEEDS ON
SHIP-BOARD.

Numerous have been the methods employed in the conveyance of plants to and from distant countries. It is quite unnecessary, however, to enter into any lengthened details of these attempts, as they resolve themselves into two kinds; the one, by which the plants are meant to be kept in a passive condition, and the other, by which means are employed to keep them growing during the voyage.

The best method of preserving plants in a state of rest is the one first recommended by Messrs. Loddiges, and now generally employed, viz., the packing them in successive layers of Bog-moss (*Sphagnum*), which answers very well for the majority of deciduous trees and shrubs, and other plants, when dispatched at the termination of their active season. For the package of Cactuses and other succulent plants, Loddiges recommend the driest sand, all vegetable matters being injurious.

But by far the greater number of plants require to be kept growing during the voyage; and, prior to the introduction of the glazed cases, a large majority of these plants perished from the variations of temperature to which they were exposed, from being too much or too little watered, from the spray of the sea, or, when protected from this, from the exclusion of light.

My late venerable friend Mr. Menzies informed me that, on his return from his last voyage round the world with Vancouver, he lost the whole of his plants from the last cause. If the voyage lasts longer than usual, and the water runs short, it is not every one who has the care of plants that will follow the example of the patriotic M. de Clieux, who, in 1717, took

charge of several coffee-plants that were sent to Martinico, and proved himself worthy of the trust. The voyage being long, and the weather unfavourable, they all died but one; and the ship's company being reduced to a short allowance of water, this zealous patriot divided his own share between himself and his precious charge, and happily succeeded in carrying it safe to Martinico, where it flourished, and was the parent stock whence the neighbouring islands were supplied.

When I reflected upon the above causes of failure, it was obvious that my new method afforded a ready means of obviating all these difficulties, so far, at least, as regarded ferns and plants growing in similar situations; and in the beginning of June, 1833, I filled two cases with ferns, grapes, &c., and sent them to Sydney under the care of my zealous friend Capt. Mallard, whose reports on their arrival, will be found in the Appendix.

These cases were refilled at Sydney in Feb. 1834, the thermometer being then between 90° and 100° in the shade. In their voyage to England they encountered very varying temperatures. The thermometer fell to 20° in rounding Cape Horn, and the decks were covered a foot deep with snow. At Rio Janeiro the thermometer

rose to 100°, and in crossing the line, to 120°. In the month of November, eight months after their departure, they arrived in the British Channel, the thermometer being then as low as 40°. These plants were placed upon deck, and were not once watered during the whole voyage, yet on their arrival at the docks they were in the most healthy and vigorous condition, and I shall not readily forget the delight expressed by Mr. G. Loddiges, who accompanied me on board, at the beautiful appearance of the fronds of *Gleichenia microphylla*, a plant now for the first time seen alive in this country. Several plants of *Callicoma serrata* had sprung up from seed during the voyage, and were in a very healthy state.

The next experiment was with coffee and other tropical plants, which were sent in safety to Ibrahim Pacha in 1834, and were followed by numberless other cases sent to all parts of the world by Messrs. Loddiges. His Grace the late Duke of Devonshire was one of the first to make use of the closed cases, by sending one of his gardeners with them to the East Indies, for the purpose of procuring some of its vegetable treasures for his magnificent conservatory at Chatsworth. The *Amherstia nobilis*, and numberless other rarities were the fruits of this expedition.

When the lamented Mr. Williams was about to leave England in 1839, for the Navigator Islands, he was anxious to take with him some useful plants, particularly the *Musa Cavendishii*. He inquired of me whether it would travel safely in one of the closed cases, and having received an answer in the affirmative, he applied to the Duke of Devonshire, who kindly gave him a young plant. Mr. W. left England on the 10th of April, 1839, and arrived at Upolu, one of the Navigator Islands, at the end of the following November. The *Musa* bore this long voyage well, and was transplanted into a favourable situation soon after its arrival. In May, 1840, it bore a fine cluster of fruit, exceeding three hundred in number, and weighing nearly a hundred weight. The parent plant then died, leaving behind more than thirty young ones. These were distributed in various parts of the island, and in the following May all were fructiferous, and produced numerous offsets. To estimate the importance of the introduction of this plant, we must bear in mind the great quantity of nutritious food furnished by the banana. Humboldt tells us that he was never wearied with astonishment at the small portion of soil, which in Mexico, and the adjoining provinces, would yield sustenance to a family for a year, and that the same extent

of ground, which in wheat would maintain only two persons, would afford support under the banana to fifty; although in that favoured region the return of wheat is never under seventy, and sometimes as much as a hundred-fold. When compared with potatoes, the banana affords forty times as much food.

One or two more instances will suffice—

Mr. Fortune was sent to China by the Horticultural Society, and has given us the comparative results of the old and new methods of conveying plants in the second edition of his “Wanderings in China.” Mr. Fortune tells us that according to a statement published by Mr. Livingstone in 1818, in the “Transactions of the Horticultural Society,” one plant only in a thousand survived the voyage from China to England. Mr. Fortune planted two hundred and fifty species in the cases in China, and landed two hundred and fifteen in perfect health.*

Very recently, Mr. Fortune paid a second visit to China, having been dispatched there by the Honourable East India Company for the purpose of procuring the different varieties of tea-plants for their possessions in the Himalayas. The fol-

* His Excellency Sir W. Reid, whilst Governor of Bermuda, made use of small portable cases, for the purpose of the interchange of plants, and with unvarying success.

lowing extract from one of his letters will show the results :—

“ We have done wonders with your cases in India, as well as in this country When I tell you that nearly twenty thousand tea-plants were taken in *safety* and in *high health* from Shanghai to the Himalayas, you will have an idea of our success. The same success attended some cases packed by me for the United States. A large number of rare and beautiful trees and shrubs sent by me at different times to this country have arrived in the best order—scarcely a species has been lost. For these results we are indebted to you.”

It is perfectly needless to specify any more instances, as the use of the closed cases has become general. There is not, I believe, a single portion of the civilized world which has not more or less benefited by their introduction, and I believe that they are now universally adopted. The French and English governments have ordered these cases to be used in their expeditions of discovery, and there are few, I imagine, who will now imitate the ill-timed economy of M. Guillemin, who was sent by the Minister of Agriculture and Commerce at Paris to Brazil, for the purpose of obtaining information respecting the culture and preparation of the tea-plant, and

the introduction of this shrub into France. M. Guillemin had personal knowledge of the efficacy of the closed plan, having carried out *Camellias* to Rio in one of my cases; and he says that his first plan had been to construct boxes on Mr. Ward's system, but the heavy price deterred * him, while the safety with which he had brought his fruit-trees † from Europe, in a box with sliding panels, induced him to fix finally on this latter mode of construction. The result I will give in his own words,—“Very pleasing was the sight to me, when the day after the ‘Heroine’ had sailed (May 20th, 1839), I beheld my eighteen precious boxes arranged two and two in such a situation as kept them steady and level, permitted them to receive light, and to have the movable panels closed in bad weather. The vigour of my tea-plants, and the lovely verdure of their foliage, had been generally admired at Rio, and I fondly anticipated the most prosperous results from my expedition. But short-lived was this satisfaction. Two days after, heavy north winds drove us off our course, the sea became more boisterous than

* The cost of glazing the whole of Mons. Guillemin's cases, would not have exceeded 20*l*.

† Had M. Guillemin reflected for one moment upon the different states of the fruit-trees, and of the tea-plants—the former being conveyed at the close, and the latter at the commencement of their active season—he would not, I think, have acted so unwisely.

is usual in these latitudes, and the necessity for closing the ports, lest the spray should irrevocably ruin my plants, caused them a great injury by the necessary exclusion of light. To the latter circumstance I attribute the first deterioration of my plants, especially those more recently set. When the sea became calmer, and permitted us to open the port-holes, the wind sweeping the surface of the waves cast a fine salt-spray upon my boxes, which doubtless proved highly injurious, since the contents of those chests that were exposed to the wind suffered much more than those of the other side.

“By the 11th of June, most of the teas had lost their foliage, and the stalks even of several had quite dried up. Some of the seeds had germinated; the young shoots were slender, long, blanched, and furnished with a few pale leaves. By the 2nd of July, in latitude 24° north, and longitude 42° west, the strongest shrubs were suffering most severely, while some had sent out suckers, and the young seedlings had assumed a greener tint. Capt. Cecille took great interest in the safety of my *protégés*, and while the leakage of some of the water-casks had compelled him to put the whole ship's crew on a slender allowance of water, he ordered me an increased quantity for the benefit of the tea-shrubs. The

vessel arrived at Brest on the 24th July, only two months after their departure from Rio, and the shrubs reached Paris in the latter end of August, reduced to one thousand five hundred in number, about one-third of the original stock, including young seedlings." *

This narrative requires no comment. I believe that not one of the plants would have perished in so short a voyage had they been protected by glass.

A few words, however, are requisite, by way of caution.

In preparing the cases for the voyage, some little attention is requisite. The objects to be attained are to admit light freely to all parts of the growing plant, and to make them sufficiently tight to prevent the escape of moisture, or the admission of saline spray or other extraneous particles. Effectually to secure this end, the glazed frames should be well painted and puttied some time before they are required for use. The part of the case which contains the mould should not be more than six or eight inches in depth; and the plants succeed better if planted in the soil than in separate small boxes, as the moisture is thereby more equally diffused.

The soil should be that in which the plants ordinarily grow; and care should be taken that all

* I am indebted for this account to Hooker's "Journal of Botany."

superfluous water be fully drained off, as luxuriant growth is not desirable. The earth, in fact, should be *moist*, but not *wet*. Another point worthy of attention is to associate plants of nearly *equal rates of growth*; as, if free and slow-growing plants are in the same case, the former would soon monopolise the light and destroy the others. This has happened in several instances. Where cases are *properly* filled with individuals of one species only, they invariably arrive in the most beautiful condition, as in several containing Norfolk Island pines, on which scarcely a dead or yellow leaf was to be seen. If the above precautions are attended to, if all bestowed the same care and attention in the packing of plants for distant voyages as Messrs. Loddiges and Guthrie, and when on ship-board, would give them the same amount of light as my friend Captain Mallard, failure would scarcely ever occur, even in voyages of the longest duration, or through the most varying climates.

Although plants in these cases will bear great variations of temperature with impunity, it does not follow that *all* plants will bear *long continued cold*. It has not unfrequently happened that cases full of precious plants, which have arrived at the Land's End in a vigorous condition, after a voyage of several months, have perished from the length of time occupied in beating up Channel in the

depth of winter. Care should, therefore, be taken that all tropical plants should be dispatched, so as to arrive in this country in mild weather.

With respect to the conveyance of seeds, all those which, from their oily nature, peculiarity of constitution, or any other cause, do not long retain their vegetative powers, are best sown in the mould, either between the other plants, or in cases by themselves. Very great numbers of rare and beautiful plants have been introduced in this way.* As to other seeds, the plan which is now found to be most successful having been published more than eighty years ago by the celebrated John Ellis, I cannot do better than detail it in the words of the author; and I am induced to do so for two reasons,—to render my subject more complete, and to do justice to the memory of a great man, whose clear account has been so strangely overlooked by modern writers.

“Our seedsmen are much distressed for a proper method to keep their seeds sound and in a state of vegetation through a long voyage An instance has come to my knowledge which illustrates the different methods of packing and stowing seeds for a long voyage, and it may be of use to

* Many years ago, Mr. Anderson, of the Botanic Garden, Chelsea, received a case full of young clove and nutmeg plants, the seeds of which had been sown on the departure of the case from Trinidad.

notice it, as it not only points out the error, but in some measure how to avoid it.

“A gentleman going to Bencoolen, in the island of Sumatra, had a mind to furnish himself with an assortment of seeds for a kitchen-garden; these were accordingly packed up in boxes and casks, and stowed with other goods in the hold of the ship. When he arrived at Bencoolen he sowed his seeds, but soon found, to his great mortification, that they were all spoiled, for none of them came up. Convinced that it must be owing to the heat of the ship's hold and their long confinement in putrid air, and having occasion to return to England, he determined in his next voyage thither to pack them up in such a manner, and to place them so as to give them as much air as he could, without the danger of exposing them to salt water; and, therefore, put the smaller seeds into separate papers, and placed them among some clean straw in a small close net, and hung it up in his cabin; and the larger ones he put into boxes, stowing them where the free air could come at them and blow through them: the effect was, that as soon as he arrived at Bencoolen he sowed them, and in a little time found, to his great satisfaction, that they all grew extremely well. It is well known to our seedsmen that even here at home, seeds kept in close warehouses and laid up

in heaps, frequently spoil, unless they are often sifted and exposed to the air. Seeds saved in moist cold summers, as their juices are too watery and the substance of their kernels not sufficiently hardened to due ripeness, are by no means fit for exportation to warmer climates.

“Our acorns, unless ripened by a warm summer, will not keep long in England; those acorns which are brought from America, and arrive early in the year, generally come in good order, owing to their juices being better concocted by the heat of their summer, and are not apt to shrivel, when exposed to the sun, as ours are.

“These hints are given to show how necessary it is to take care that the seeds we send should be perfectly ripe and dry.”*

* “Directions for Captains of Ships, Sea Surgeons, and other curious persons who collect seeds and plants in distant countries, in what manner to preserve them fit for vegetation.”—John Ellis, London, 1770.

CHAPTER V.

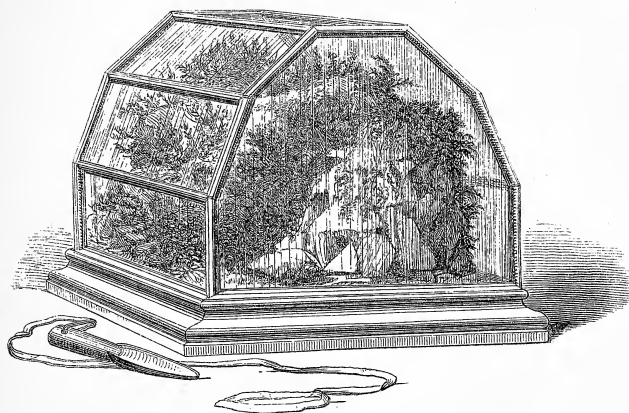
ON THE APPLICATION OF THE "CLOSED" PLAN
IN IMPROVING THE CONDITION
OF THE POOR.

E'EN in the stifling bosom of the town,
A garden in which nothing thrives, has charms
That soothes the rich possessor; much consoled,
That, here and there, some sprigs of mournful mint,
Of nightshade, or valerian, grace the well
He cultivates. These serve him with a hint
That Nature lives, that sight-refreshing green
Is still the livery she delights to wear,
Though sickly samples of the exuberant whole.
What are the casements lined with creeping herbs,
The prouder sashes, fronted with a range
Of orange, myrtle, or the fragrant weed,
The Frenchman's darling ? are they not all proofs
That man, immured in cities, still retains
His inborn, inextinguishable thirst
Of rural scenes, compensating his loss
By supplemental shifts, the best he may ?
The most unfurnished with the means of life,
And they that never pass their brick-wall bounds,
To range the fields, and treat their lungs with air,
Yet feel the burning instinct; over head
Suspend their crazy boxes, planted thick,
And watered duly. There the pitcher stands,
A fragment, and the spoutless tea-pot there;
Sad witnesses how close-pent man regrets
The country; with what ardour he contrives
A peep at Nature, when he can no more.

COWPER.

The book of Nature is written in every language, and lies open to all the world. The works of Creation speak in the common voice of reason, and want no interpreter to explain their meaning, but are to be understood by people of all languages upon the face of the earth. There is no speech nor language, where their voice is not heard.

SHERLOCK.



ON THE APPLICATION OF THE "CLOSED" PLAN IN
IMPROVING THE CONDITION OF THE POOR.

AMONG the numerous useful applications of the closed cases, there is one which I believe to be of paramount importance, and well deserving the attention of every philanthropist. I mean their application to the relief of the *physical* and *moral* wants of densely crowded populations in large cities. Among the members of this population there are numbers, who, either from early

associations, or from that love of Nature which is implanted, to a greater or less degree, in the bosom of all, are passionately fond of flowers, and endeavour to gratify their taste at no small toil. Some years ago a lady in Bristol thus wrote to me,—“ I have now one of your cases made by a glazier here who has quite enlivened his small dark room with fresh green plants, and very grateful he feels to you for your discovery. I think you must have much satisfaction in thinking how much pleasure you have been enabled to give in the world, and how often the sorrowful have been cheered by watching the fresh vegetation near them, when illness or their occupations in life confine them to the dark smoky streets of a large town. Many country walks, too, have been taken by those, who would not otherwise have stirred from their homes, to find suitable plants to fill their cases.”

About the same time, I received a letter from the glazier above referred to,* a portion of which I copy, as it graphically describes the situation and feelings of thousands of those who like him-

* Mr. Ivey, of College Street, whom I have lately had the pleasure of visiting, and my readers will, I am sure, rejoice with me in learning that he is now reaping the reward of honest industry and un-deviating integrity. Mr. Ivey showed me some marine *Algae*, which were looking very healthy, after confinement in a closed case for more than twelve months.

self are compelled to live in cities,—“I have, with great pleasure and with greater profit, read your work on plants in closed cases, and have now outside my sitting-room window a Lilliputian landscape, entirely through reading that work, obtained by enclosing a space with glass. In this case, which has no sun upon it at this time of the year until near two P.M. and gradually coming on later until it will not be visited for some months by that luminary, I have a variety of ferns, wood-sorrel and many other wild plants, which many persons here very much admire, wondering how I could keep them alive *without* air. All the back of my premises and close to my cases are some blacksmiths’ forges, and a great deal of smoke pouring from a bake-house chimney. I am quite certain that if I admitted the air of the yard, my present green-house would soon be a black-house. In conclusion, let me say, that if at any time my services will be of use to you, they will be most readily at your command, having been from a boy exceedingly fond of growing *anything* in the earth; for I well recollect when a row of chick-weed against a wall which bordered our yard was to me as great a delight as a new fuchsia or a purple nasturtion would be to an amateur of the present day, and when, after having sown some barley in a space of

eighteen feet by ten, in March 1816, I had a bed of beautiful high level green, I thought I was a wonderful gardener. I still delight in these things, and I must say that I am extremely obliged to you for a great enjoyment I now possess, for when I come in tired with business, fatigued perhaps in body and mind, there's my little green-house looks so refreshing, that I cannot help feeling its influence soothing my mind, and rewarding me for all the trouble I have taken with it."

"Yes, in the poor man's garden grow
Far more than herbs and flowers:—
Kind thoughts, contentment, peace of mind,
And joy for weary hours."

Peter Collinson (whose pious memory ought to be a standing toast at the meetings of the Horticultural Society) used to say, that he never knew an instance in which the pursuit of such a pleasure as the culture of a garden affords did not either find men temperate and virtuous, or make them so. And this may be observed as an undeniable and not unimportant fact relating to the lower classes of society, that wherever the garden of a cottage or other humble dwelling is carefully and neatly kept, neatness and thrift and domestic comfort will be found within doors.

I have yet another glazier to introduce to my

readers—Mr. Smith, of Wellclose Square, whom I mention, as his form of *aquarium* for gold and silver fish is the best with which I am acquainted. It consists of a glazed case about two feet by one, and one and a-half feet in depth, one foot of which is occupied by the water. At the bottom is a rude representation of a cromlech, which serves to conceal a small pipe, from which issues a jet of water, which in hot weather produces a very pleasing effect, and serves at the same time to carry off, by means of a waste pipe, the impurities which are the constant attendants upon a London atmosphere. This has been established for more than six years; but the fish do not live more than from six to eighteen months, owing, most probably, to the want of vegetation.

I will now endeavour to show how the glazed cases may be made subservient to the benefit of the poor, and to point out how cheaply and easily this may be effected. A box lined with zinc, and having three or four openings in the bottom to ensure perfect drainage, will be required for the reception of the plants, and glazed frames can be procured anywhere at a most moderate cost. What would be still better, would be to convert the spaces between the windows into closed cases. The plants to furnish them can be

procured abundantly in the woods in the neighbourhood of London. Of these I will mention a few. The common Ivy grows most beautifully, and can be trained over any part of the case, agreeably to the pleasure of the owner. The Primroses in early spring, will abundantly repay the labour of fetching them, continuing for seven or eight weeks in succession to flower as sweetly as in their native woods. The lovely Woodsorrel, *Oxalis acetosella*, grows and flowers most freely when thus enclosed. This plant was in full flower when I was first honoured by a visit from the late Dr. Neill of Edinburgh, one who did more to advance the science of horticulture in his native country than any who had preceded him. Dr. Neill told me that he had never succeeded in causing this plant to flower at Canon Mills, where almost everything did well under his untiring skill. To the above plants may be added the *wood Anemone*, the yellow *Pimpernel*, the *Veronica*, the *Stitchwort*, and a host of other early-flowering plants. Mosses and ferns are great additions, but some of the latter are more valuable than others, in consequence of the longer duration of their fronds, — such as *Lastræa multiflora*, *spinulosa*, and other allied species. There are likewise many common garden plants procurable at little cost — such as the lily of the valley, Solomon's seal,

musk plant, myrtles, box, &c., which grow without the least trouble. All the vacant spaces in the case may be employed in raising small salad, radishes, &c. ; and I think that a man would be a bad manager, who could not in the course of a year pay for his case, out of its proceeds. The above remarks apply to situations where there is little solar light.

Where there is a larger amount of sun, a greater number and variety of flowering plants will be found to thrive—such as the spring bulbs, crocuses, irises, hyacinths, narcissuses, tulips, &c., with several kinds of roses, passion-flowers, and numerous beautiful annuals, the species of *nemophila*, *convolvulus*, *gilia*, *lupines*, &c. The vegetation, in fact, can be diversified in an endless degree not only in proportion to the differing degrees of light and heat, but likewise by varying the quantity of moisture : thus, with precisely the same aspect, ferns and bog-plants might be grown in one case, and aloes, cactuses, *Mesembryanthemums*, and other succulent plants in another.

These cases form the most beautiful blinds that can be imagined, as there is not a window in London that cannot command throughout the year the most luxuriant verdure : indeed, by means of their instrumentality, London, or any

other large town, might be converted into one vast garden. Admitting far more light into the dwellings, continually purifying the atmosphere, and furnishing food to the mind as well as the body,—they would be invaluable to those who have not the opportunity of visiting the country. They might be made, moreover, the means of illustrating the antiquities of any country—by erecting in them models of old towers, castles, gateways, &c., and which, when covered with plants, would form *tableaux vivans* of the highest interest. Nothing can be conceived more cheerful than the appearance of rooms thus furnished, and in proportion as the use of these cases becomes more general among the middle and higher classes, a new field of healthful and profitable industry will be opened to the poor, who might not only be employed in procuring plants from the country, but whose ingenuity might be called into play in executing the models above referred to in sandstone, chalk, or other suitable material. I need not, however, dilate upon this point, as these varied applications must be obvious to all.

But I must here caution the poor against indulging a taste for what are called fancy-flowers—things this year rewarded with gold medals, and the next thrown upon the dunghill. Be-

lieving that all human pursuits ought to be estimated in exact proportion as they tend to promote the glory of God, or the good of man, let us for a moment compare the empty chase after fancy flowers with the legitimate pursuits of horticulture and floriculture. So far from the love of God and the good of his fellow-creatures being the end and aim of the fancy florist, he values everything in proportion as it is unnatural and unattainable by the rest of mankind. "A long time must elapse ere the world can hope to see a perfect pansy!" says one of these fancy writers. How the world is to benefit by this Phoenix, when it does arrive, he will, of course, inform us in his next publication.

Let the poor remember that their "single talent" should be well employed; let them learn to estimate things according to their true value, and devote their time and attention to the legitimate pursuits of horticulture and floriculture. It would appear that innumerable plants have been created with latent useful qualities, for the purpose of exercising the mind, and rewarding the industry of man, who, by acting in conformity with the laws of Nature, is enabled to produce the most beneficial results. Thus, if increased succulence be the point aimed at, the plants must be the more abundantly supplied

with water; if increase of flavour, then less water, but a larger proportion of sun and light, which latter are to be withheld if the natural flavour of the plant be too strong. Who could have imagined from the appearance of the *wild* carrot or parsnip, the crab, the celery, and the endive, that all these would form such important additions to our tables. There is, in fact, scarcely a vegetable or fruit, that owes not a portion of its excellence to horticultural exertions, directed by science. And so, with respect to floriculture; that man would be fastidious indeed, who would not appreciate and enjoy the increased beauty and fragrance of a double rose or fine stock. I have said enough as to the physical results of these pursuits, and will endeavour to point out the probable moral effects. The highest and best feelings of our nature are excited by the contemplation of the works of God. The Divine Word has commanded us to "consider the lilies of the field, how they grow," and there is, probably, no study which leads the mind of the pursuer more directly to the Author and Giver of all good things, and fills the heart of man with greater joy and thankfulness than the study of that branch of Natural History which comprehends the Vegetable kingdom.

"The infinite variety of forms, the nice adap-

tation of these to their several functions, the beauty and elegance of a large number, and the singularity of others, but above all, their pre-eminent utility to mankind in every state and stage of life, render them objects of the deepest interest both to rich and poor, high and low, wise and unlearned; so that arguments in proof of the power, wisdom, and goodness of God, drawn from the *vegetable kingdom*, are likely to meet with more attention, to be more generally comprehended, to make a deeper and more lasting impression upon the mind, to direct the heart more fervently and devotedly to the Maker and Giver of these interesting beings, than those which are drawn from more abstruse sources, though really more elevated and sublime." We cannot better illustrate the truth of the above observations than by quoting a passage from the life of a celebrated traveller.

" Whichever way I turned, nothing appeared but danger and difficulty. I saw myself in the midst of a vast wilderness, in the depth of the rainy season, naked and alone, surrounded by savage animals, and man still more savage. I was five hundred miles from the nearest European settlement. All these circumstances crowded at once upon my recollection, and I confess that

my spirits began to fail me. I considered my fate as certain, and that I had no alternative but to lie down and perish. The influence of religion, however, aided and supported me. I reflected that no human prudence or foresight could possibly have averted my present sufferings. I was, indeed, a stranger in a strange land, yet I was still under the protecting eye of that Providence who has condescended to call himself the stranger's friend. At this moment, painful as my reflections were, the extraordinary beauty of a small moss * in fructification, irresistibly caught my eye. I mention this to show from what trifling circumstances the mind will sometimes derive consolation, for though the whole plant was no larger than the tip of one of my fingers, I could not contemplate the delicate conformation of its roots, leaves and capsules, without admiration. Can that Being (thought I) who planted, watered, and brought to perfection, in this obscure part of the world, a thing which appears of so small importance, look with unconcern upon the situation and sufferings of crea-

* The moss which engaged Mungo Park's attention so much in the desert, is the *Fissidens bryoides*, as I have ascertained by means of original specimens given to me by his brother-in-law, Mr. Dickson.—
SIR J. W. HOOKER.

tures formed after his own image? Surely not! Reflections like these would not allow me to despair. I started up, and, disregarding both hunger and fatigue, travelled forwards assured that relief was at hand, and I was not disappointed."—PARK'S *Travels in Africa*.

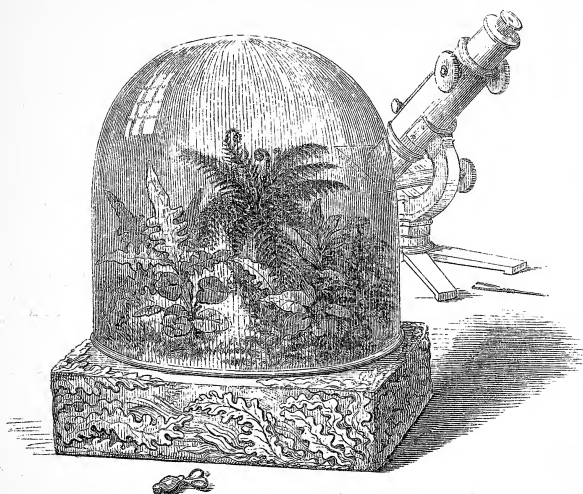


CHAPTER VI.

ON THE PROBABLE FUTURE APPLICATIONS OF
THE PRECEDING FACTS.

It will be enough, if, after having led the way on a new territory of investigation, we shall select one or two out of the goodly number of instances, as specimens of the richness and fertility of the soil.

CHALMERS' BRIDGEWATER TREATISE.



ON THE PROBABLE FUTURE APPLICATIONS OF THE
PRECEDING FACTS.

THE application of the closed cases to the illustration of physiological and pathological botany, must be sufficiently obvious to all who are interested in such enquiries. In most of the experiments which have been hitherto undertaken by vegetable physiologists, the results have been rendered liable to some doubt, in consequence of the fancied necessity for the open exposure of the plants to air, whereas now the utmost certainty is attainable.

I will content myself with specifying a few of the more important instances in which the new method will be found of practical utility :—

1. Observations, strictly comparative, can now be made on the effects of different soils, manures, &c., in cases divided into several compartments, each compartment being filled with different soils, but the same plants.

2. To determine the powers possessed by plants, of absorbing and selecting various substances by their roots.

3. To ascertain the existence and nature of the excretions from the roots, the deleterious characters of which, if they exist, being rendered very problematical by the fact of plants in a state of nature occupying the same situation for ages.*

4. To show the effects of poisons upon plants.

5. To test the influence of light in protecting plants from the effects of low temperatures. This has already been proved by the same species surviving in the light, but dying in the dark portions of a closed case.

In the severe winter which occurred many years ago, the noble plant of *Araucaria excelsa*, in the Pinetum at Dropmore, was killed. I believe

* Drummond states that he has no doubt that many of the Swan River *Orchidaceæ*, of the genera *Thelimytra*, *Diuris*, &c. have continued to flourish in half a square inch of earth for ages.

that the plant would not have suffered had light been admitted through the covering which protected it from the cold; and this could easily have been effected by means of melon lights, &c.

6. To determine various important points respecting those numerous and highly interesting tribes of plants and animals which, from their extreme minuteness, or fugacious nature, have hitherto eluded observation, but which the naturalist in his study will now be enabled to watch, microscopically if required, during the whole period of their growth. Let the man of the world despise, if he will, these inquiries. There is nothing little in Nature, save those little minds which are unable to comprehend great truths. These microscopic objects—

“To us invisible, or dimly seen.

. . . . Yet these declare

Thy goodness beyond thought, and power divine.”

In a work like this, it is impossible to enter into any lengthened detail respecting this mighty world of wonders. There is one class, however, which has excited in no small measure, the attention of naturalists—I mean those small *algæ*, whose reproductive spores, escaping from the parent plant, appear to be endowed with voluntary motion, swimming about until they reach

some fixed point, to which they can attach themselves, and thus commence their vegetable existence. Small as these bodies are, they fulfil a most important office in creation; so important, indeed, that the largest beast of the field would be less missed than one of these, and I cannot but imagine that the Divine Wisdom has given them their locomotive power that not one of them should perish. Connected, as I believe it is, with this highly interesting subject, I must here allude to one of the most remarkable deviations from ordinary growth, with which the botanical physiologist is acquainted. In the *Laminariæ*, the footstalk of the leaf or frond lasts for a great number of years, whilst the laminated portion is renewed annually, the new growth commencing between the apex of the footstalk and the base of the laminated part, until the preceding growth of the expanded part becomes thrown off.* The persistent footstalks serve for the attachment and growth of successive myriads of the smaller seaweeds, and nothing can be conceived more beautiful than these fairy-like submarine forests, clothed with lovely vegetation of varied hues,

* In many parts of our coast, these are cast on shore in large quantities, and, after having fulfilled their destiny in their natural element, contribute, in the way of manure, to increase our crops of potatoes, &c. Truly, Nature is a wonderful economist.

and enlivened by the presence of minute crustacea and other animals, which sport and gambol among the tiny branches, like squirrels on the trees. The *lichens* and *mosses* on the trees in the northern regions subserve the same purposes as these *algæ* in the seas.

“Maximus in minimis certe Deus, et mihi major,
Quam vasto coeli in templo, astrorumque caterva.”

7. To watch the development of fungi, &c. I had been struck with the extraordinary account of the rapidity of growth of *Phallus fatidus*, which was said to attain the height of four or five inches in as many hours. Having procured three or four specimens in an undeveloped state, I placed them in a small glazed case. All but one grew during my temporary absence from home. I was determined not to lose sight of the last specimen, and observing one evening that there was a small rent in the volva, indicating the approaching development of the plant, I watched it all night, and at eight in the morning the summit of the pileus began to push through the jelly-like matter with which it was surrounded. In the course of twenty-five minutes it shot up three inches, and attained its full elevation of four inches in one hour and a half. The entire life of the *Phallus*, after its development

from the volva, was four days. Extraordinary as this rapidity may appear, I believe it to be far surpassed by other plants of this family, as I was informed by Lady Arden, who has paid great attention to them, that the lives of some were so brief as scarcely to allow of sufficient time to finish her drawings of them. Marvellous are the accounts of the rapid growth of cells in the fungi; but in the above instance it cannot for a moment be imagined that there was any actual growth of new cells, but merely an elongation of the erectile tissue of the plant. These cases may likewise be made available in clearing up the confusion which exists in the determination of the genera and species of this family. Out of one *species* (*Thelephora sulphurea*), according to Fries, no less than eight *genera* have been formed in consequence of degeneration or imperfect states of growth.

Lastly, the scientific naturalist will be assisted in exploring that debateable ground on the confines of the animal and vegetable kingdoms, where in our present state of ignorance, it is often impossible to determine the point at which the one ends or the other begins.

I shall conclude my little work with pointing out the application of the same principles, which have proved so successful in the growth of plants,

to animals and to man; an application far outweighing in importance all that has hitherto been effected. In a letter addressed to Sir W. J. Hooker, and published in the "Companion to the Botanical Magazine," for May 1836, I thus wrote—"I feel well-assured that this method of importing plants would likewise be extremely useful in the introduction of many of the lower but most interesting tribes of animals, which have never yet been seen alive in this country." In April 1838, in a lecture delivered by Professor Faraday,* on the closed cases, at the Royal Institution; and later in the same year at the meeting of the British Association at Liverpool, I expressed my opinion, that animals and man might benefit by the same plan of treatment which had proved so successful with plants. In 1842, in the first edition of this work, I stated, that a little reflection will convince us that this idea is not so visionary as it might appear at first sight, as I had proved by numerous and long-continued experiments that the air of London, if duly sifted, was perfectly fitted for the respiration of all plants, even of those with the most delicate leaves, such as the *Trichomanes speciosum*, which may, in fact, be considered as a test-plant, as regards the purity of the air. Now this same

* Vide Letter of Prof. Faraday, in the Appendix.

condition of the atmosphere, so essential to the well-being and even existence of such plants, we have it in our power to obtain in large towns ; and by warming and moistening the air we can, in fact, closely imitate any climate upon the face of the earth. It cannot be denied that in a pure and properly regulated atmosphere we possess a remedial means of the highest order for many of the ills that flesh is heir to ; and every medical man knows well, by painful experience, how numerous are the diseases which, setting at nought his skill and his remedies, would yield at once to the renovating influence of pure air. The difficulty to be overcome would be the removal or neutralization of the carbonic acid given out by animals ; but this in the present state of science could easily be effected, either by ventilators, or by the growth of plants in connexion with the air of the room, so that the animal and vegetable respirations might counterbalance each other. The volume of the air, with the quantity of vegetable matter required, as compared with the size and rank of the animal in Creation, would be a problem well worthy of solution. Experiments of this kind upon any scale might be instituted in the Zoological Gardens, where the moping owl and ivy-mantled tower might be associated. In one of my own houses, about ten

feet square, sufficiently close for the growth of the most delicate ferns, a robin lived for several months, at the end of which time he escaped, in consequence of the accidental opening of the door.

Among the diseases incident to man, which would be most materially benefited by pure air, I shall allude only to two, *viz.*, measles and consumption. This is not the place to enter into any long discussion on medical points; but believing firmly as I do, that a properly regulated atmosphere is of more importance in these diseases than all other remedial means, it would have been unpardonable in a work like the present to have passed them over without notice. In the crowded districts of large towns the direct mortality arising from measles is always great, but nothing, I believe, compared with the numbers that die at various and distant intervals in consequence of neglect during the disease. Nearly all this distress and mortality might be averted were there proper rooms provided for the reception of the children of the poor when labouring under this complaint, or of communicating it in favourable seasons. In my examination before the Commissioners* for inquiring into the

* Vide Report of the Commissioners for inquiring into the state of large towns and populous districts. London, 1844.

state of large towns, I urged the above considerations upon their notice, in regard to measles; and long continued experience has convinced me that the amount of benefit that would be derived from the adoption of the plan I have recommended, would be scarcely inferior to that which has been effected by vaccination in controlling the ravages of small pox. With respect to consumption, could we have such a place of refuge as I believe one of these closed houses would prove to be, we should then be no longer under the painful necessity of sending a beloved relative to a distant land for the remote chance of recovery, or too probably to realize the painful description of Blackwood, "Far away from home, with strangers around him, a language he does not understand, doctors in whom he has no confidence, scenery he is too ill to admire, religious comforters in whom he has no faith, with a deep and every day more vivid recollection of domestic scenes,—heart-broken — home-sick — friendless and uncared-for—he dies."

Another point, especially worthy of consideration, is the free admission of light into the dwellings of all, both rich and poor.* "Let in the sun, and shut out the doctor," says an old Italian

* "Truly the light is sweet—and a pleasant thing it is to behold the sun."

proverb. I have already mentioned the effects of light upon vegetation ; and its influence upon the animal economy, although not so immediately obvious, is not the less striking. Milne-Edwards tells us, that if tadpoles be nourished with proper food, and are exposed to the constantly renewed action of water (so that their branchial respiration be maintained) but are entirely deprived of light, their growth continues, but their change into the condition of air-breathing animals is arrested, and they remain in the form of large tadpoles. Dr. Edwards also observes, that persons who live in caves and cellars, or in very dark and narrow streets, are apt to produce deformed children ; and that men who work in mines are liable to disease and deformity beyond what the simple closeness of the atmosphere would be likely to produce. Mr. Watson, of the Deaf and Dumb Asylum, informed me that, *cæteris paribus*, more deaf and dumb children were born in dark than in light dwellings. Sir James Wylie stated, some years ago, that the cases of disease in the dark side of an extensive barrack at St. Petersburg, have been uniformly, for many years, in the proportion of three to one of those on the side exposed to strong light.

The more the body is exposed to the influence of strong light, the more freedom do we find,

cæteris paribus, from irregular action and conformation. Humboldt has remarked, that, among several nations of South America, who wear very little clothing, he never saw an individual with a natural deformity; and Linnæus, in his "*Lachesis Lapponica*," enumerates constant exposure to solar light as one of the causes which render a summer's journey through high northern latitudes as peculiarly healthful and invigorating.

In enumerating the benefits likely to arise from the use of the closed cases, it must not be forgotten that, as a means of administering comfort to the afflicted and distressed in body or mind, they are invaluable. I have had repeated applications from parties who have been confined, from paralysis or other causes, to a bed or sofa, either in country or town, and they have thus been enabled to beguile many a weary hour; and with numberless persons labouring under that most distressing of all human maladies, mental aberration, I have much reason to believe that their soothing influence would have a most beneficial result; and how easily could this be effected. Take the long gallery at St. Luke's—the gloomy tone of which is sufficient to depress the mind of a sane person—and introduce a dozen or two of closed cases into the walls, containing *tableaux vivans* of old ruins or portions of natural scenery,

covered with its fresh and appropriate vegetation, and you would have one of the most beautiful promenades conceivable.

In concluding my little work, no one can be more sensible than myself of its many imperfections. The unremitting toil of general medical practice allows of little time for scientific inquiries; and I must rest satisfied with having ministered matter for men of riper wits and deeper judgments to polish. Deeply convinced of the great practical utility and high importance of these researches, I hope yet to see the day when in our Universities and our public schools, the study of Natural History will be deemed at least as worthy of attention as an ode of Pindar, or a proposition of Euclid. All sorts and conditions of men would benefit by a more extended knowledge of those *immutable* laws, which influence the well-being of everything that has life. The medical man would find his endeavours to improve the sanitary condition of his fellow creatures no longer thwarted by the delusive fallacies of mesmerism or homœopathy, or by defective and mischievous legislation; and the divine would surely not be the less able expounder of the Word of God, by being able to demonstrate practically to his flock, that through

the length and breadth of Creation, man “cannot stir where universal love not reigns around.” As it is, the students are presented

“With an universal blank
Of Nature’s works, to them expunged and razed,
And wisdom, at one entrance, quite shut out.”



APPENDIX.

APPENDIX.

(A)

*Copy of a Letter to DAVID DON, Esq., read before
the Linnean Society of London, June 4th, 1833.*

WELLCLOSE SQUARE, June 4th, 1833.

MY DEAR SIR,

THE difficulty of conveying ferns from foreign countries has long been matter of regret to the cultivators of that most interesting family of plants. About three years ago I was led to make some experiments upon the subject, in consequence of noticing a seedling of *Aspidium Filix-mas*, and one of *Poa annua*, on the surface of some moist mould in a large bottle, in which I had buried the chrysalis of a *Sphinx*. Curious to observe how vegetation would proceed in so confined a situation, I placed the bottle, loosely covered with a tin lid, outside one of my windows, with a northern aspect. This cover allowed a sufficient change of air for the preservation and development of the plants, and, at the same

time, prevented the evaporation of the moisture within. In the bottle these plants remained for more than three years, during which time not one drop of water was given to them, nor was the cover removed. The *Poa* flowered the second year, but did not ripen its seeds; and about five or six fronds of the *Aspidium* were annually developed, but neither thecæ nor sporules were produced. These plants accidentally perished, from the rusting of the lid and the consequent admission of rain, which caused them to rot. During the last twelve-month I have tried this method with more than thirty species of ferns, with uniform success. Many other plants which grow in moist situations will succeed equally well when treated in this way. To mention one instance: I transplanted some roots of *Listera Nidus-avis* about three weeks ago. Those which I placed in my fern-boxes grew most rapidly, while the remainder, treated in the usual manner, completely withered away. I have the pleasure of submitting two of my boxes to the inspection of the Linnean Society. My valued friend Capt. Mallard, whose active zeal in the cause of Science is well known to many Fellows of the Linnean as well as of the Zoological Society, has engaged to convey these boxes on an experimental voyage

to New Holland; and I hope, on his return, to find that they have not lost their character by being transported.

I am, my dear Sir, yours very truly,

N. B. WARD.

TO DAVID DON, Esq.

(B)

*Copy of a Letter from CHARLES MALLARD, Esq.,
R.N., to the Author.*

HOBART TOWN, November 23rd, 1833.

SIR,

You will, I am sure, be much pleased to hear that your experiment for the preservation of plants alive, without the necessity of water or open exposure to the air, has fully succeeded.

The two boxes entrusted to my care, containing ferns, mosses, grasses, &c., are now on the poop of the ship (where they have been all the voyage); and the plants (with the exception of two or three ferns which appear to have faded), are all alive and vigorous.

During the very hot weather near the equator, I gave them once a light sprinkling of water, and that is all they have received during the passage.

All the plants have grown a great deal, particularly the grasses, which have been attempting to push the top of the box off.

I shall carry them forward to Sydney, according to your instructions, and have no doubt of delivering them into the hands of Mr. Cunningham in the same flourishing state in which they are at present.

Allow me, in conclusion, 'to offer to you my warm congratulations upon the success of this simple but beautiful discovery for the preservation of plants in the living state upon the longest voyages; and I feel not a little pride in having been the instrument by which the truth of your new principle has been fully proved by experiment. I am, Sir, &c.,

CHARLES MALLARD.

TO N. B. WARD, Esq.

(C)

Copy of a Letter from MR. TRAILL to the Author.

CAIRO, April 30th, 1835.

SIR,

I BEG to acknowledge the receipt of your letter of the 2nd ult., wherein you request information as to the state of the plants sent by you in the Nile steamer.* The collection consisted, I believe, of one hundred and seventy-three species, contained in six glazed cases, two of which only were forwarded to me from Alex-

* In August 1834.

andria. The one which you mention as having been fitted up with talc, together with three others, were sent on to Syria* immediately on their arrival in Alexandria, so that I had no opportunity of seeing them. I have, however, the pleasure to inform you that the Egyptian portion of the collection was received here in the very best condition: the plants, when removed from the cases, did not appear to have suffered in the slightest degree; they were in a perfectly fresh and vigorous state, and, in fact, hardly a leaf had been lost during their passage. Your plan I think decidedly a good one, and ought to be made generally known.

I am, Sir, &c., J. TRAILL.

To N. B. WARD, Esq.

(D)

*Copy of a Letter from G. LODDIGES, Esq., to
the Author.*

HACKNEY, February 18th, 1842.

MY DEAR SIR,

IN reply to your inquiries respecting the importation of living plants in your cases, I beg leave to say that my brother and I have, since

* These cases were seen by Col. Higgins of the Engineers, in the garden of the Seraglio, at Beyrout, at the late evacuation of that place by the Egyptians.

1835, made trial of more than five hundred cases to and from various parts of the globe, with great variety of success, but have uniformly found, wherever your own directions were strictly attended to—that is, when the cases were kept the whole voyage in the full exposure to the light upon deck, and care taken to repair the glass immediately in cases of accident—the plants have arrived in good condition; but we have never found this so well attended to as in those cases with which we have been favoured by your friends, and particularly by Capt. Mallard, of the “Kinnear;” indeed amongst all we have sent out or received, none have arrived in such good order as those brought by this gentleman. I wish we had more that possessed his love for Natural History, and would take the same care which he has done, as we should not then have to deplore the number of importations totally ruined, even in your cases, simply for the want of the light of day, and these too under the care of captains who engage that they shall be kept upon deck, when the moment we are out of sight, they stow them away below, and they are never more thought of until their arrival: from experience in this mode of transportation we are enabled perfectly to see by their state whether they have been placed properly or not; for we find that

there cannot be a worse mode of sending living plants than in these same cases, so placed in the dark. Some of the cases have been opened in fine order after voyages of upwards of eight months; in short, nothing more appears to be wanting to ensure success in the importation of plants, than to place them in these boxes properly moistened, and to allow them the full benefit of light during the voyage.

I remain, my dear Sir,

Ever yours most sincerely,

GEORGE LODDIGES.

To N. B. WARD, Esq.

(E)

*Copy of a Letter from DR. LINDLEY, to the
Author.*

HORT. SOC., *January 15th, 1842.*

MY DEAR SIR,

As far as our experience goes, your plant-cases are by far the best that have ever been contrived. We uniformly find the plants in them, even from India, in excellent order, provided the glass has not been broken, or they have not been over-watered when originally packed up. The latter arises from the packers not considering how little water is really requisite for plants which lose none of it. The former acci-

dent can hardly occur if the glass is well secured with a strong and close wireguard.

Pray believe me, very truly yours,

JOHN LINDLEY.

To N. B. WARD, Esq.

(F)

*Copy of a Letter from MR. J. SMITH, to the
Author.*

ROYAL BOTANIC GARDEN, KEW, *January 24th*, 1842.

DEAR SIR,

IN reply to your inquiry respecting the practical results obtained by adopting the plan of close-glazed cases, for the transfer of living plants from one country to another, I beg to say that the several cases which have arrived at this garden on that plan have shown that although all plants so treated may not succeed, still the deaths are but few in proportion to the number that we have witnessed in cases having open lattice or wire-work lids, covered with tarpauling or some such covering. It is much to be regretted that close-glazed cases were not in use during the years that the botanical collectors were employed in New Holland and the Cape of Good Hope, for this garden: a very great number of the plants which they sent home were always dead on their arrival, consequent on the imperfect protection

during the voyage to this country; therefore, from my experience, I have no hesitation in considering your plan the best for the purpose desired.

I am, sir, yours truly,

J. SMITH.

TO N. B. WARD, Esq.

(G)

*Copy of a Letter from D. MOORE, Esq. to the
Author.*

ROYAL BOTANIC GARDEN, GLASNEVIN, DUBLIN,
February 1st, 1842.

MY DEAR SIR,

I FIND all the species of ferns I have tried, to grow well either in glazed Wardian cases, under hand-lights, or in close frames, when the *external air can be excluded*, where some of the slender-growing kinds develope their fronds to such a degree of beauty and elegance as I have never observed excepting under such circumstances.

I may especially notice our rare and beautiful *Trichomanes speciosum*, Willd., which can be cultivated to very great perfection on this plan, and is here, at this time (1st February, 1842), in a fine state of fructification, producing larger fronds than it usually does in its native habitat. *Hymenophyllum Wilsoni*, Hook., and *H. Tunbridgense*, Sm., delight to grow in these close cases, and, when properly cultivated, attain to a larger size

than they generally do in their habitats, producing fine fructiferous fronds.

Adiantum Capillus-Veneris, Linn., can only be seen to perfection in a cultivated state when grown in this manner, when it developes the fronds very large, and forms a beautiful object.

When the weather is very hot in summer I sometimes give them a sprinkling of water with the syringe, taking care to close the glasses as quick as possible, which greatly refreshes them, especially when in frames; but during six or seven months of the year they never receive a drop of water artificially.

The various foreign species of *Lycopodia* I have tried in this way luxuriate amazingly. The only British species I have endeavoured to cultivate was *L. clavatum*, Linn., which grew very well, and when *hung up*, its long, slender, pendulous branches had a very graceful appearance.

I find many of the species of *Hepaticæ* thrive well in closed cases, especially those of the *Marchantiæ* and the larger species of *Jungermannia*, some of which have been cultivated here during the last three years, in a common frame, made as air-tight as possible.

The beautiful *Hygropila irrigua*, Taylor, grows well, and is now (1st February, 1842) in an incipient state of fructification.

Fegatella conica, Taylor, grows very strong, and also *Lunularia vulgaris*.

Jungermannia epiphylla, Linn.; *furcata*, Linn.; *asplenioides*, Linn.; *emarginata*, Ehr.; *nemorosa*, Linn.; *Taylori*, Hook.; *trilobatum*, Linn.; *lævigatum*, Wils.; *cochleariformis*, Weis; *tomentella*, Ehr.; *Hutchinsiae*, Hook.; have all been successfully cultivated in this collection.

I remain, my dear Sir, very truly yours,

D. MOORE.

TO N. B. WARD, Esq.

(H)

Letter from E. CHADWICK, Esq.

SOMERSET HOUSE, October 14th, 1842.

SIR,

ON a suggestion made to me by Professor Owen in the course of some conversation, I forward for your acceptance a copy of a report on the sanitary condition of the labouring population. Mr. Owen stated that you had been attending to the effects of climate on the animal creation, as well as on that in which you have made so important and brilliant a discovery. I am induced, therefore, to lose no time in soliciting your attention to the facts stated in the Sanitary Report. The inquiry as to the atmospheric impurities in some important cases is there opened, but by no means completed or concluded, and I

should be much obliged by any information which you may obtain bearing on the practical means of improving the sanitary condition of the labouring population.

I remain, Sir, your very obedient servant,

EDWIN CHADWICK.

To N. B. WARD, Esq.

(I)

GENERAL BOARD OF HEALTH, WHITEHALL,
April 1st, 1851.

MY DEAR SIR,

IF you should have recently made any additional observations on the influence of light in health or disease, I should be glad if you would favour me with it, as it may just now, perhaps, be turned to account with reference to the Repeal of the Window Duties.

I am very faithfully yours,

SOUTHWOOD SMITH.

To N. B. WARD, Esq.

(J)

CLAPHAM RISE, *April 3rd, 1851.*

MY DEAR SIR,

I WISH it were in my power to adduce any fresh or striking instance of the beneficial effects of light. Corroborating proofs of the facts already before the public are daily and hourly occurring. But what need is there of

any proof? If there be any truth in the saying, "Deus nil frustra fecit." God did not make the light of heaven for a Chancellor of the Exchequer to give or withhold at his will and pleasure. It would be quite as lawful and just for the rulers of a kingdom to attempt to raise a revenue by poisoning the air that we breathe, or the food that we eat, as by interfering with the full and free enjoyment of Heaven's first-born and most precious gift. Some future Gibbon in his "History of the Decline and Fall of the British Empire," in enumerating the causes of such decline might well place in a prominent rank the profound ignorance of its legislators upon subjects of the most vital importance to the well-being of the community. Believe me to be, my dear Sir,
yours very truly,

N. B. WARD.

TO DR. SOUTHWOOD SMITH.

(K)

ROYAL GARDENS, KEW, *April 4th*, 1851.

MY DEAR SIR,

You pay me the compliment to ask my opinion on your "Wardian Cases," but their value has been so long tested, not only in this country, but really and truly all over the world, that I have only to say what every one interested in the progress of botany and horticulture can

say :—they have been the means, in the last fifteen years, of introducing more new and valuable plants to our gardens than were imported during the preceding century ; and in the character of “ Domestic Green-houses,” if I may so speak ; *i.e.* as a means of cultivating plants with success in our parlours, our halls, and our drawing-rooms, they have constituted a new era in horticulture.

I shall never forget the expression made use of by the late Mr. Loddiges to me one day when speaking of your cases ; “ Whereas I used formerly to lose nineteen out of twenty of the plants I imported during the voyage, nineteen out of twenty is now the average of those that survive.”

Believe me, my dear Mr. Ward, most faithfully
yours,

W. J. HOOKER.

(L)

*Extract from last Report on the state of the Royal
Gardens, Kew.*

Sir William Hooker states in his Report on the Kew Gardens, that there have been sent abroad, mainly to our own territories, between January 1847 and December 1850, living rooted plants, in glazed Wardian Cases, as follows :—“ To Ascension Island, 330 plants (mostly trees and shrubs calculated to bear exposure to the sea-breezes and

the most powerful winds, and the success of these has been beyond all expectation, affording shelter and protection where none could be obtained before); Bombay, 160; Borneo, 16; Calcutta, 211; Cape of Good Hope, 60; Cape de Verdes, 20; Ceylon, 136; Constantinople, 90; Demerara, 57; Falkland Islands, 118; Florence, 28; Grey Town, Mosquito, 30; Hong Kong, 108; Jamaica, 124; Lima, 33; Mauritius, 36; Port Natal, 29; New Zealand, 57; Pará, 33; Port Philip, 33; St. Domingo, 34; Sierra Leone, 71; Sydney, 392; South Australia, 76; Trinidad, 215; North West Africa, 65; West Australia, 46; Van Dieman's Land, 60; Valparaiso, 34. Total 2722, despatched in sixty-four glazed cases, besides four cases of Pará grass.—N.B. From nearly all the abovementioned colonies or countries very rich and valuable returns have been sent either to the garden or the museum, or both."

(M)

Letter from DR. FARADAY, in answer to an inquiry concerning his Lecture on the Closed Cases.

ROYAL INSTITUTION, November 4th, 1851.

MY DEAR SIR,

I CANNOT but regret you should have reason to murmur, and should be glad to testify to the originality of the thought with you as far

as I can, but my memory is not good. However, I have luckily found the notes I used on the evening, which was the 6th April, 1838. At the bottom of the page headed *application*, you will see the note of *application to men and animals*, in respect of which I read that the atmosphere, &c. of climates, as of Madeira, &c., might be obtained and adjusted for patients, even in towns. You may make any use of this that you like, only return me the notes.

Ever truly yours,

M. FARADAY.

(N)

Letter to SIR J. PAXTON.

CLAPHAM RISE, *August 21st*, 1852.

SIR,

A NEW edition of my little work on the "Growth of Plants in closely glazed Cases" is now in the press. In that work, published in 1842, I strongly advocated the application of the same principle which had proved so beneficial in the growth of the most delicate plants in the centre of crowded cities, to the relief of some diseases incidental to man, selecting two for example, measles and consumption. I cannot suppose that you have ever seen my work, as in advocating the erection of a Sanatorium for the

Hospital for Consumption, you did not mention my name, although your arguments were the same as my own.

As I must allude to this in my preface, it will give much pleasure to state upon your own authority, that your observations were quite independent of mine.

Apologising for thus troubling you, I have the honour to be, Sir,

Your most obedient servant,

N. B. WARD.

TO SIR J. PAXTON.

(O)

CLAPHAM, *August 27th*, 1852.

MY DEAR SIR,

WHEN Suminsky's work on the development of Ferns first came into my hands, a strong desire to repeat his observations led me to seek for seedlings where they were most likely to be found, namely, in my own fern case, at Kew, and other conservatories; but I soon found such sources were unsatisfactory, for although I could obtain abundance of plants in which the organs of reproduction (?) described by him were clearly discernible, yet I could rarely find the moving ciliated bodies said to perform such an important part in their development. There were, too, differences evidently specific that I could not

comprehend, and which were a bar to anything like correct observation. It was therefore obvious, if the investigation were to be followed up successfully, that some means must be devised for raising an unlimited supply of any desired species. The usual method of sowing fern-seed, by scattering it over damp, sandy mould, is very uncertain, for the mould itself will frequently contain the seeds of other species; and even if the crop of plants come true to the sowing, it is difficult properly to separate sand and other extraneous matter from the young frond previously to placing it under the microscope, without danger of injuring its delicate structure. My plan, therefore, was to procure some soft, porous, potter's ware material that should readily imbibe and retain moisture upon which to sow the seed desired to be raised. While searching for such material I met with a peculiarly fine and soft sandstone, admirably adapted for the purpose. This I prepared by breaking it into pieces of from one to two inches square, and less than one inch thick, afterwards rendering the faces parallel and smooth by rubbing them on a flat stone. The reason for thus adjusting the size and smoothness of the pieces was simply to facilitate their being placed for observation on the stage of a microscope. Before sowing the seeds on these prepared pieces

they were baked in an oven to destroy any organic life that might be lurking about them. They were then piled in dishes, moistened with DISTILLED water, and covered with bell-glasses, preparatory to receiving the seed. The seed to be sown was obtained from a recently gathered frond laid fruiting side down, between two sheets of white paper, on the top of which was laid a book or piece of board to keep them in place. In the course of three or four days the seed was discharged from the capsules, and removed to the damp stone by turning the stone down upon it, of course taking care that the seed did not lie too thickly. In about sixty hours germination had commenced, and thenceforth daily progressed into maturity. In this way I have raised several species of ferns without a failure; abundant means being thus afforded for observing their development from the commencement of germination up to the perfect plant.

I have been repeatedly told by those who have attempted to raise ferns from seed, that I might sow what I pleased, but something I did not want would spring up. Most likely such had been the experience of my informants, although the reason for it was not obvious. My experiments proved the contrary, and demonstrated most unequivocally, that, by observing the requi-

site conditions, any species may be raised, if the seed sown be fresh and fully matured.

This principle of raising ferns is applicable to several important purposes besides that of the facility it affords for observing and studying the laws of their development. In the first place many kinds now rare and valuable, or even unknown in this country from the difficulty of bringing them home, even with the protection of your glazed cases, might be introduced with facility by sowing the seeds in the country where they grow,* on some suitable material, whether sandstone, Bath brick, tile, wood, bark, or even charcoal—wood or bark suggests itself in the case of such as are parasitic in their habits—and enclosing them in a small glass case, a case so much smaller than would be required for full-grown plants, that it might be a cabin companion for a long voyage. Secondly, it is frequently desirable, even in this country, to raise particular species with some greater degree of certainty than, from various ill-understood causes, is generally found practicable. Again, experiments on this principle may be tried in a great variety of ways until the true habits of obscure species are

* On referring to your book "On the Growth of Plants in Closely-glazed Cases," p. 29, near the bottom, I find that the same idea is expressed in reference to the use of surface-mould as a medium.

accurately determined. Some ferns are impatient of removal; such may be raised from seed on suitable pieces of stone or wood, and afterwards introduced into pots, or crevices in walls and rockwork prepared to receive them.

I conceive that a Ward's case, artistically filled with such admirable sandstone as my experiments have been made upon, but which I am sorry not to be able to tell you the source of, might be judiciously sown with seeds of small moisture-loving ferns, and form one of the most exquisite of drawing-room or cottage conservatories, and which, in its gradual progress to maturity would delight the eye, expand the understanding, and warm the heart in love and gratitude towards the Author of that portion of creation which is truly the most beautiful, as well as most essential to our healthy and happy existence on earth, I mean the Vegetable kingdom.

No kind of vegetation that I am acquainted with has ever struck me with such wonder, admiration, and delight, as the little crops of ferns raised as you have seen them, and as I have now endeavoured to show you how to raise; and nothing would please me better than to see others deriving similar enjoyment from this simple and accessible source. Any one who makes a garden of this kind under a bell-glass, must observe that

the material on which the seed is sown is so porous that the requisite amount of moisture will pass to the top by capillary action when applied to the bottom of it. Also, that with an abundance of light, the sun must not shine directly upon it.

I remain, with the greatest regard and esteem,
Yours very truly,

HENRY DEANE.

To N. B. WARD, Esq.

Since writing the above, the following observations, in the "Quarterly Review" for 1842-6, have come to my notice. They so beautifully express what I would have done but could not, that I must add it as a postscript. After speaking of the application of the closed cases in the conveyance of plants, the editor says:—

"But while this mode of conveyance answers the purposes of science, a much more beautiful adaptation of the same principle is contrived for the bed-room of the invalid. Who is there that has not some friend or other confined by chronic disease, or lingering decline, to a single chamber, one we will suppose who, a short while ago, was among the gayest and most admired of a large and happy circle, now, through sickness, dependent, after her *one* stay, for her minor comforts

and amusements on the angel visits of a few kind friends, a little worsted work, or a new Quarterly, and in the absence or dulness of these, happy in the possession of some fresh gathered flowers, and in watering and tending a few pots of favourite plants, which are to her as friends, and whose flourishing progress under her tender care offers a melancholy but instructive contrast to her own decaying strength. Some mild autumn evening her physician makes a later visit than usual, the room is faint from the exhalations of the flowers, the patient is not so well to-day, he wonders that he never noticed that mignonette, and those geraniums before, or he never should have allowed them to remain so long. Some weighty words on oxygen and hydrogen are spoken; her poor pets are banished for ever at the word of the man of science, and the most innocent and unfailing of her little interests is at an end. By the next morning her flowers are gone, but the patient is no better; there is less cheerfulness than usual, there is a listless wandering of the eyes after something that is not there; and the good man is too much of a philosopher not to know how the working of the mind will act upon the body, and too much of a Christian not to prevent the rising evil if he can; he hears with a smile her expression of regret for her

long-cherished favourites, but he says not a word. In the evening a largish box arrives directed to the fair patient, and superscribed 'keep this side uppermost, with care.' There is more than common interest on box-opening in the sick chamber. After a little tender hammering, and tiresome knot-loosening, Thompson has removed the lid, and there lies a large oval bell-glass fixed down to a stand of ebony, some moist sand at the bottom, and here and there, over the whole surface, some tiny ferns are just pushing their curious little fronds into life, and already promise, from their fresh and healthy appearance, to supply in their growth and increase, all the beauty and interest of the discarded flowers, without their injurious effects. It is so. These delicate exotics—for such they are—closely sealed down in an airtight world of their own, flourish with amazing rapidity, and in time produce seeds, which provide a generation to succeed them. Every day witnessing some change, keeps the mind continually interested in their progress, and their very restriction from the open air, while it renders the chamber wholesome to the invalid, provides at the same time an undisturbed atmosphere more suited to the development of their own tender frames. We need scarcely add, that the doctor, the next morning finds the wonted cheerful smile

restored, and though recovery may be beyond the skill, as it is beyond the ken, of man, he at least has the satisfaction of knowing that he has lightened a heart in affliction, and gained the gratitude of a humble spirit, in restoring, without the poison, a pleasure that was lost."



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